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Sixty-inch Heavy Forge Lathe.

Our illustration represents a lathe recently brought out by the Niles Tool Works, of Hamilton, Ohio. The lathe was designed especially for use in forges, for rough-turning or finishing heavy shafts, rolls, cranks, etc., but the requirements for such work make the lathe equally well adapted to machine shop use, where extra heavy work is to be done, all its proportions being such as to fit it for the heaviest duty.

The lathe swings 60 inches over the ways and 46 inches over the carriage. The cone is mounted on an independent spindle, with a steel pinion geared into an internal gear on the back of the face-plate. It has five steps for a belt 4½ inches wide, and has two sets of back gears, thus giving fifteen changes of speed to the face-plate. The main spindle is 10 inches in diameter at the front end, and the bearing is 15 inches long. The face-plate is bolted fast to the spindle.

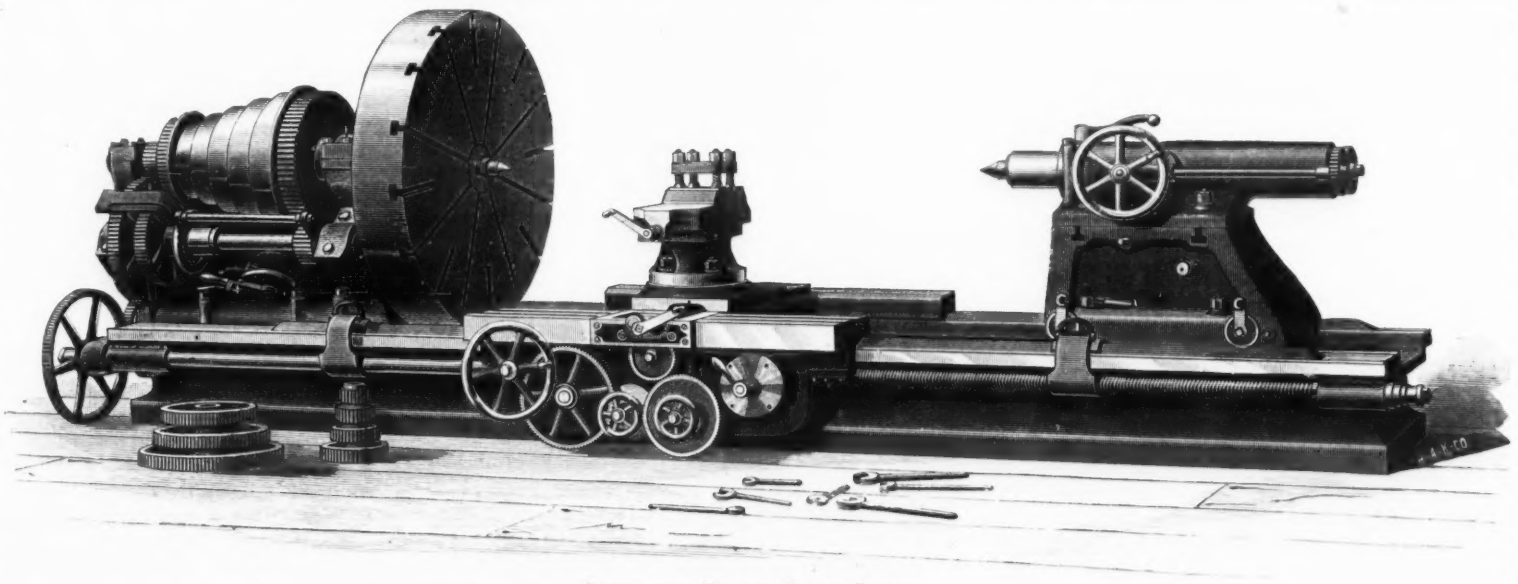
The carriage is 68 inches long, made of the stiffest form, accurately fitted to the bed its entire length, and is gibbed both front and back. The rest has compound movement, with longitudinal, cross and angular feed. The tool is held by four clamps and studs. The tool-rests can be removed at will, and then the carriage presents a large, flat surface, on which work may be bolted for boring.

The feed mechanism is made in the strongest manner, and very rigidly supported in the apron, to enable it to withstand the severest duty. The feed is reversed by means of strong tumbler gearing in the head, so that no change in the stud gear is needed in cutting either right or left-hand threads. The feed-reversing lever is very conveniently placed on the front side of the head-stock. The lead screw is placed well up under the shears of the bed, and the nut so arranged as to bring the strain on the carriage as direct as possible. The foot-stock is held down by four bolts, and it is also provided with a strong pawl, which engages with a rack cast in the bed. This pawl is raised or lowered by means of the hand knob seen at the side of the foot-stock, and, when engaged, makes a positive lock for the foot-stock, entirely doing away with all danger of slipping.

The foot-stock has four rollers, mounted on eccentric studs with clamps. By turning the studs a quarter-turn and clamping the straps shown in the illustration (and which are connected to these studs), the rollers are brought into engagement with the bed, and the entire foot-stock is raised slightly from the ways, and can be readily adjusted to any desired position.

The upper slide of the foot-stock is also held by four bolts. This arrangement allows the foot-stock to be set over for taper work without unclamping from the bed, and is very convenient when working with heavy pieces. The foot-stock screw is geared at the back end, and arranged to be operated by the hand-wheel shown at the front in the illustration.

The lathe is also provided with heavy steady and follower rests, and the steady rest has an opening of extra size to admit large shafts. Adjustable hinged supports for the lead screw are also provided, which are arranged to slide upon the ways. These can be removed from the bed at will, or adjusted to suit the convenience of the operator.

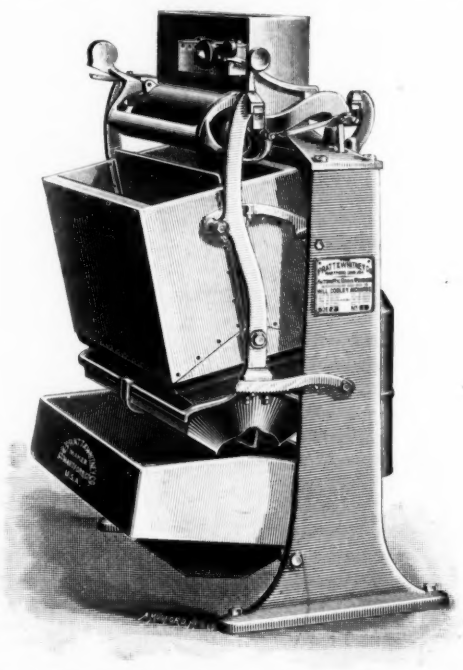


SIXTY-INCH HEAVY FORGE LATHE.

In about ten years this country will be all trusts, or trusts will be relegated to the shades of the past; which it will be, no fellow can tell.

A New Self-regulating Automatic Grain Scale.

The new Self-regulating Automatic Grain Scale shown on this page has recently been brought out by the Pratt & Whitney Company, of Hartford, Conn. In some respects this new scale may be considered the outgrowth—as it is the successor—of the Hill Automatic Grain Scale, whose manufacture was undertaken by this company several years ago, and which, as our readers will remember, was illustrated and described in the AMERICAN MACHINIST of November 17, 1888. The successful and accurate weighing of grain by automatic machinery is a problem which, though attempted for many years by a multitude of inventors, has until recently been considered by practical millers as almost unsolvable; but we are assured that all of the difficulties incident to this problem have now been successfully overcome. The record already made by the "New Model Pratt & Whitney Grain Scale" seems to fully substantiate this claim, prominent people in the grain trade testifying in the most unequivocal terms to the accuracy and value of the scale.



A NEW SELF-REGULATING AUTOMATIC GRAIN SCALE.

The manufacturers call especial attention to the fact that their "New Model" grain scale is a new and comprehensive invention, based on newly discovered principles of operation. The former machines, of which a considerable number are still in service, made excellent records when running under favorable conditions and in the hands of experienced operators, but proved too complicated and too sensitive of adjustment for general use. This circumstance rendered it necessary to begin anew, and, by careful research and experiment, which has extended over several years, to produce the Self-regulating Automatic Scale, which is now put forward as being a simple, effective and reliable instrument for weighing and registering all kinds of grain. Besides controlling the original patents of Mr. J. W. Hill, the Pratt & Whitney Company now own, as assignees, upwards of forty letters patent, granted and pending, for an extensive system of improvements in grain-weighing machinery covering, as they believe, all that is of essential value for that purpose. The new improvements are the inventions of Mr. Charles H. Cooley, who is in charge of the company's grain scale department, and of Mr. Francis H. Richards, mechanical expert, under whose supervision the New Model scale has been developed.

The double-chambered oscillating style of grain bucket of the former machine has been retained, it being considered the most reliable type for general use; in other portions of the machine, however, radical changes have been made.

In order to secure reliability of operation, all adjustments, except the single adjustment of the main weight to bring the load to the required amount, have been entirely discarded; so that the scale may be safely handled and cared for by ordinary workmen and mill hands. The principle has been followed of constructing the machine in adjustment, instead of making it adjustable into working condition. Hence the scale is not only a working machine, but is also an instrument of precision. By the same means, also, the parts are reduced to the least possible number, and these of the simplest description. The frame is cast in a single piece, and the entire valve mechanism, together with the scale beam, is assembled on the top plate, which includes also the supply chute. This permits a method of manufacture at once simple and reliable.

All of the working parts are supported and

connected by pivots or knife edges, fitted for free action to avoid liability of clogging from dust and moisture. All of the parts are of metal, no leather, rubber, wood, brushes or other perishable material being used in any of the scales; and none of the parts require any lubrication other than that furnished by the inevitable dust of the mill.

One of the indispensable features of an automatic grain scale is the regulator whereby the scale shall be automatically retarded or stopped whenever the weighing is faster than the grain is taken away. In this machine the regulator is a movable hopper of peculiar construction, located below the grain bucket and connected with the valve mechanism in an entirely new and original manner, whereby the cut-off valve is made to serve a double purpose—first, to cut off the grain in the ordinary working of the machine, and second, to close the supply chute on the operating of the regulator hopper by an overload of grain. This valuable feature effects the regulation without the use of a separate or special regulator valve, thereby avoiding what has been hitherto one of the most serious impediments to the reliable operation of a self-regulating scale. For this purpose the cut-off valve is operated through a "shiftable valve actuator" which has a normally fixed position on the scale beam (or valve), and is temporarily shifted into an inoperative position on the descent of the regulator hopper, thus, in a sense, throwing the valve mechanism "out of gear."

The two portions of the valve mechanism for operating the reducing valve and the cut-off valve, respectively, are so organized in connection with the scale beam and the valve-actuating devices that the machine is completely "self-resetting." By this is meant that, however misused or tampered with (unless actually blocked in some way), the scale starts or goes on properly when released or let alone, there being no "let-off" catches or like unreliable devices whose premature action will disarrange or stop the operation of the scale.

The weight, or load, which must be weighed by an automatic scale, is, in fact, made up of three quantities, viz.: the actual load in the grain bucket, the momentum of the loaded scale beam and grain bucket, and the impact of the drip column at the moment the load is completed. To reduce the impact to an inappreciable quantity, the drip column is in this machine reduced both in height and size to the smallest practicable dimensions; and to overcome the still more objectionable momentum, the valve mechanism is provided with a patented "reducing valve" and valve-actuating devices, whereby the first flow of grain into the bucket is gradually reduced in a peculiar manner and the nearly loaded bucket brought to rest close to its poising position without jar or shock. An incidental but very important advantage arising from this feature of the scale is the extreme rapidity with which the bucket may receive the major part of its load, thereby largely increasing the normal capacity of the scale, without sacrificing certainty or accuracy of operation.

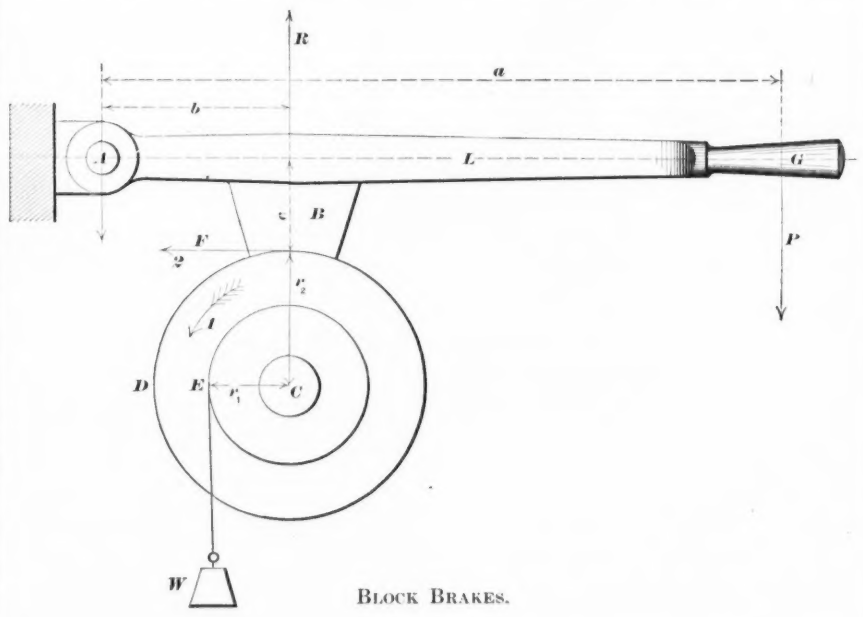
A unique feature of the scale is the new system of discharging the load without using any part of the momentum of the loaded scale beam, or the weight or force of the falling grain, so that the scale will run continuously, however slowly the grain may be supplied to it. This is effected by a feature of the valve mechanism whereby a portion of the weight of the cut-off valve is suddenly thrown upon the scale beam the instant this passes the actual poising point, thus furnishing from an extraneous source ample power for unhooking the bucket catches, and this without the addition to the scale of a single piece, or interfering in the least with its resetting quality.

A new and effective stop-motion is furnished when required, for stopping the scale whenever any predetermined quantity of material has been delivered, as for filling bins and cars.

The register is connected with the scale beam in such a manner as not to affect or resist the movement of the beam while the weight is being taken, being actuated only on the upward movement of the grain bucket, when there is an abundance of power for the purpose. By taking the register readings daily, the proprietor obtains an accurate knowledge of each day's business. By the present method of taking the yield once a month or once in several months, only the average yield is found, while the actual yield and the daily variations in the yield are not discovered. The frequent readings are also a means for instantly detecting any improper working of the milling machinery, which might otherwise go unnoticed and result in substantial losses.

Nothing is more important to the management of a manufacturing business, especially where large quantities of valuable material are consumed, than to have constant and accurate knowledge of the work in detail. Such knowledge is only to be had by some kind of measurement and accounting, and this in the milling trade includes, of course, the weighing of the grain and the product before and after each of the principal processes of manufacture. This, so far as possible, should of course be done daily, and this is rendered entirely feasible by the use of the new automatic scale—one scale being used at the elevator to weigh the uncleaned grain, the second scale being set over the break rolls to weigh the cleaned grain and show the shrinkage in cleaning, and a third used to weigh the bran, all of this being accomplished without labor.

These scales are made in a series of sizes, and are adapted for the weighing of all kinds of grain, including meal and bran, and have been fully tested in regular commercial work, where, we are assured, they are found to meet every requirement. In one test extending over two months, and made by Smith, Northam & Co. in their extensive works at Hartford, Conn., 50,000 bags of corn meal were weighed, every bag of which was reweighed on a platform scale, the automatic scale being always found correct. At the Jewell Milling Co.'s, Brooklyn, N. Y., a half bushel "New Model" scale ran steadily day and night for one year on uncleaned wheat, delivering over two and one-half millions of loads of one-half bushel each without requiring any care, or suffering any loss of accuracy. These truly remarkable results indicate that, in undertaking the solution of this problem, the Pratt & Whitney Co. have been entirely successful, and have produced a machine worthy of their excellent reputation.



BLOCK BRAKES.

Block Brakes.

It is often desirable to use brakes for controlling the motion of weights which have to be lowered as in cranes. There are several classes of brakes used for this purpose. In this article, which has been written in response to a number of questions which we have received relating to this subject, we shall consider the simplest kind of brake only, such as is shown in the illustration. In our investigation we shall freely use symbols, but these symbolic expressions need not deter those who are not thoroughly familiar with such expressions from following the subject, as we shall endeavor to make it as plain as possible. This brake consists of a lever L fulcrumed at A; a block B pressing against the drum D, which produces between the surfaces of contact a friction sufficient to prevent the weight W from moving. The weight W is attached to a rope which is wound around a second drum E. The pressure between the block B and the drum D is produced by a force P applied at G. The problem is to find the magnitude of the force P, which can hold the weight W.

Problems of this kind are readily solved by the principle of the lever. To explain this principle, let us first consider the lever L, without paying any attention to the rest of the arrangement of the brake. Suppose that a force P is applied at G, holding in equilibrium a force R which acts in the line $R\,C$ parallel but opposite to the direction of the force P. Now the force P tends to turn the end G of the lever downwards, while the force R tends to turn the lever upwards. To compare the energy of one of these forces with that of the other one, we must find the moments of these forces. These moments are found in the following manner: The line a drawn from the fulcrum A perpendicular to the direction in which the force P acts is called the arm of this force; and the product obtained by multiplying this arm by the force P will be the moment of that force. So also the line b drawn from the fulcrum A perpendicular to the direction in which the force R acts is called the arm of the force R, and the product of this arm into the force R will be the moment of that force.

Now these two moments evidently measure the energy of rotation of the two forces P and R about the fulcrum A; and for a condition of equilibrium the two moments must be equal. This condition is expressed by symbols as follows:

$$P \times a = R \times b, \qquad (1)$$

In this expresion, P represents the number of pounds of the force applied at G; a its arm in inches; R the number of pounds of the force acting in the line $R\,C$; and b its arm in inches. If we take a in feet, then b must also be taken in feet. To illustrate, let R be 750 pounds, b, 15 inches, and a, 60 inches, then according to formula (1), $P \times 60 = 750 \times 15$, hence,

$$P = \frac{750 \times 15}{60} = 187.5 \text{ pounds},$$

which is the force applied at G to hold in equilibrium the force of 750 pounds acting in the line $R\,C$.

This same principle of the lever can be applied to the drums D and E. Suppose the drum E is 12 inches diameter, its radius r_1 will be 6 inches; and neglecting the thickness of the rope from which the weight W is suspended, then the arm on which the weight W acts will be the radius r_1, and the moment will be $W \times r_1$. If the weight is 500 pounds, then its moment will be $500 \times 6 = 3{,}000$ inch-pounds.

In our illustration the weight W is supposed to be held in equilibrium by the frictional resistance between the block B and the drum D; let us designate the friction by F. If we assume that the pressure of the block B against the drum D is uniformly distributed over the surfaces of contact, the direction in which the force R acts will pass through the center C; and under these conditions it must be evident that the arm of the friction or force F is the radius r_2 of the drum D; if this drum is 40 inches diameter, then the arm of the force F will be 20 inches, and the moment of this force will be $F \times r_2 = F \times 20$. For a condition of equilibrium the moment of W must be equal to the moment F, or, in symbols,

$$W \times r_1 = F \times r_2, \qquad (2)$$

hence, using the same data as before,

$$F = \frac{W \times r_1}{r_2} = \frac{500 \times 6}{20} = 150 \text{ pounds}.$$

The friction F bears a certain ratio to the pressure R, and this ratio depends on the material used for the block B and the drum D; it also depends on condition of the surfaces in contact. Assume that, in the case before us, the friction is equal to $\frac{1}{5}$ of the pressure R; then, if the friction is 150 pounds, the pressure R must be equal to $150 \times 5 = 750$ pounds. The pressure R is generally found in another way, namely, by dividing the friction by a coefficient of friction. If, for instance, the friction is equal to $\frac{1}{5}$ of the pressure R, then its coefficient will be .2; and if the friction is equal to 150 pounds, the pressure R will be $\frac{150}{.2} = 750$ pounds, as before. This rule for finding the pressure R we can express in symbols; let m denote the coefficient of friction, and F the friction, then, $\frac{F}{m} = R$; from which we get,

$$F = m \times R. \qquad (3)$$

Now, we have seen that a weight of 500 pounds suspended as here shown requires a pressure R of 750 pounds to prevent it from moving, and we have also found that with a lever as here shown, we require at G a force of 187.5 pounds to produce a pressure R of 750 pounds; hence, to prevent the weight W of 500 pounds from moving, we must apply at G a force of 187.5 pounds.

Now, the whole of the foregoing operation can be combined into one rule, and the simplest and easiest way to do so is to use the symbols previously adopted.

From formula (1) we get

$$P = R \times \frac{b}{a}. \qquad (4)$$

According to formula (2) we have $W \times r_1 = F \times r_2$, and according to formula (3) we have $F = m \times R$. If we now substitute in formula (2) for F its value $m \times R$, we get

$$W \times r_1 = m \times R \times r_2. \qquad (5)$$

From this last formula we obtain

$$R = \frac{W \times r_1}{m \times r_2}. \qquad (6)$$

If we now substitute in formula (4) for R its value as found in formula (6), we have

$$P = \frac{W \times r_1}{m \times r_2} \times \frac{b}{a}. \qquad (7)$$

This last formula is the rule expressed in symbols for finding the force P to hold a given weight W suspended as shown in the illustration, the length of lever and diameters of drums being also given. To show the correctness of this rule, let us find the force P from the data as previously stated. Here we only need to substitute in formula (7) for the symbols their numerical values, and then solve the problem as indicated by the signs.

$$P = \frac{500 \times 6}{.2 \times 20} \times \frac{15}{60} = 187.5 \text{ pounds as before.}$$

If we carry our investigations a little further, we shall find that the rule as given in formula (7) holds true only when the fulcrum A lies on the line in which the force F is acting, or, in other words, when the fulcrum A lies in the horizontal line drawn tangent to the top of the drum. If the fulcrum A is placed above the line F, as here shown, and the drums tend to revolve in the direction as indicated by arrow 1, then the force F will act with a leverage c, and will tend to turn the lever in the same direction as that of the force P. Here then we have two forces F and P tending to turn the lever in one direction, and one force R tending to turn the lever in an opposite direction. Now the measure of energy of rotation about the point A of the force F is its

moment, which is $F \times c$. Hence we have

$$P \times a + F \times c = R \times b. \quad (8)$$

From this we get

$$P \times a = R \times b - F \times c. \quad (9)$$

According to formula (3) we know that $F = m \times R$; substituting this value for F in formula (9), we get

$$P \times a = R \times b - R \times m \times c. \quad (10)$$

From this we get

$$P = R \times \frac{b - m \times c}{a}. \quad (11)$$

But according to formula (6)

$$R = \frac{W \times r_1}{m \times r_2};$$

substituting this value for R in formula (11), we have

$$P = \frac{W \times r_1}{m \times r_2} \times \frac{b - m \times c}{a}. \quad (12)$$

And this formula is the rule expressed in symbols for finding P when the fulcrum is placed at a given distance above the drum D. To show the application of this rule, let c be 5 inches, the other data remaining as before. Now, substituting the numerical values for the symbols in formula (12), we have

$$P = \frac{500 \times 6}{.2 \times 20} \times \frac{15 - .2 \times 5}{60} =$$

$$750 \times \tfrac{14}{60} = 175 \text{ pounds.}$$

If we suspend the weight W from the other side of the drum E, so as to produce rotation in a direction opposite to that as indicated by arrow 1, then the force will tend to lift the lever, and therefore the force P must be increased. Under these conditions it is easy to show that the formula (12) will become

$$P = \frac{W \times r_1}{m \times r_2} \times \frac{b + m \times c}{a}. \quad (13)$$

Keeping the data as before, we have, under the last condition,

$$P = \frac{500 \times 6}{.2 \times 20} \times \frac{15 + .2 \times 5}{60} =$$

$$750 \times \tfrac{16}{60} = 200 \text{ pounds.}$$

From the foregoing it appears that, in order to reduce the force P, the friction F must tend to move the lever in the same direction as that in which the force P is acting. If the fulcrum A is placed below the line F, and the weight suspended as shown, the friction will tend to lift the lever; therefore for finding P under this condition we must use formula (13). If, on the other hand, the weight is suspended from the other side of the drum E, and the fulcrum A is placed below the line F, the friction will tend to pull the lever downwards, and therefore we must use formula (12) for computing P.

The friction of the journal C will also affect the required force P, but when this friction is small as compared with the friction between the block and drum, as is generally the case, it may be neglected.

A Boston press dispatch details the following: A case involving $3,000,000 has been won by a New York firm in the United States Circuit Court in this city. Suit was brought by the Hat Sweat Manufacturing Company of New York against J. P. Gilman's Sons of Haverhill, Mass., to compel the defendants to pay certain royalties on patents controlled by the plaintiffs. It was a test case. The plaintiffs control patents on all kinds of sweat bands used in hats, and licenses to use those bands are held by 165 manufacturers in this country. The defendants in this case refused to pay royalties on the ground of false representations made by the plaintiffs when the license was issued in July, 1886.

A decree, signed by Judge Colt, rules that no false representations were made, and that the defendants must pay the full amount of royalties, interest, and costs. The amount paid annually to the New York firm by the 165 licensees aggregates $500,000, and as the patents run six years longer, the sum total involved in the decree is $3,000,000, without reckoning the interest. This sum comes out of the pockets of all the hat manufacturers of the country. The defendants have acknowledged judgment, and have paid the sum at issue in their case.

Polishing Wheels.

BY F. H. TREACY.

SECOND PAPER.

The plain flat-faced wheel shown in Figs. 1 and 2 being the one most in use for ordinary work, will serve every purpose in giving a description of the way in which such wheels may be constructed so as to be adapted for use in the frame shown in a preceding paper. The dimensions of the wheel shown are: Sixteen inches diameter, $2\frac{1}{2}$"

Fig. 1.

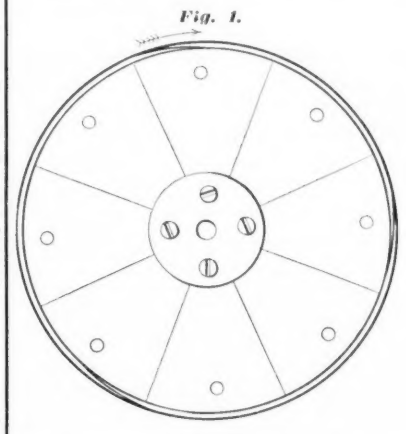
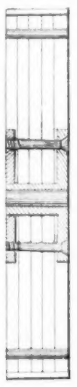
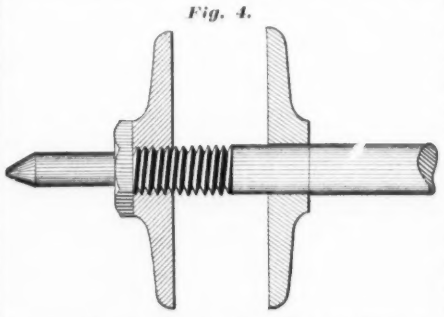


Fig. 2.



face; flanges, 6" diameter, $\frac{5}{8}$" thick; length of hub from inside of flange, $2\frac{1}{8}$"; outside diameter, $1\frac{5}{8}$". The hole in flanged hub is bored taper, to fit the spindle described in first paper. The flanges and hub should be trued up all over. The four bolt holes are spaced off an equal distance from each other, also from the center. The holes in the loose flange are tapped to receive the $\frac{3}{8}$" flat-head bolts (see Fig. 2). The wooden portion of the wheel is made of white pine, and consists of five layers of $\frac{1}{2}$" stuff, each layer or disk being made up of eight sectors neatly jointed, the whole being firmly glued together, care being taken to break joints so that none of the dowels pass through any of the joints. When thoroughly dry, fit the flanges and dowels as shown in Fig. 2. The wheel may then be put on a taper mandrel, and the sides and face finished in a lathe, and two or three coats of shellac put on the sides. Select good oak-tanned leather of average thickness and pliability. Shave down each end for the lap joints of a sufficient number of pieces to encircle the wheel; on one end of each strip shave off the leather from the skin side, and from the hair side on the opposite end, so as to make each lap not less than 4" long. The pieces should be soaked in water until quite pliable, in order to admit of their being tightly stretched over the wheel as they are pegged and glued to it. The glue should only be applied to as much surface of the wheel as one piece of leather will cover at a time. After coating a portion of the wheel with glue, place the hair side of one of the pieces next the wheel, and fasten with wooden pegs. After the end

Fig. 4.



is secured, a good tension should be kept on the leather while the piece is being fastened; each row of three pegs may be 2" or 3" apart. The first piece should not be entirely fastened to the wheel until the next strip has its end secured, when the first strip may be lapped over it neatly after being coated with glue, and finally secured with the pegs. The laps should be arranged as in Fig. 1, the arrow indicating the direction in which the wheel should be run.

I think it will be clearly understood from the foregoing that wheels of other diameters and various widths and forms of face may be made on the same general plan. Some provision, however, must be made for solid emery wheels being used. Fig. 3 may be made from the same patterns as the flanges in Fig. 2, and finished in the same manner, with the addition of a portion of the hub being threaded, and a nut to fit the same. With this arrangement one spindle answers for all wheels. Fig. 4 is specially adapted for solid wheels, and is made to the same dimensions as the spindle shown in a former paper, except that on one end it is turned parallel one inch diameter to a shoulder $6\frac{1}{4}$" from the end, one flange being shrunk on, the other loose. The threaded portion of the spindle may be made a length to suit the widest wheel used.

Double-arm Machine-molded Pulleys.

BY W. A. JONES.

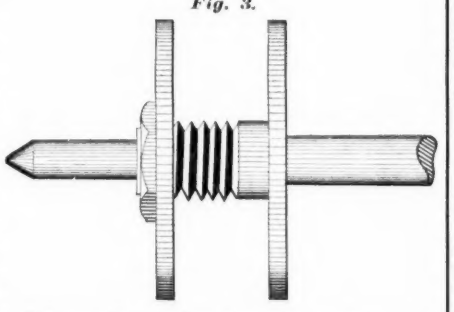
The manufacture of pulleys has become such an important factor, and competition in them so sharp, that all manner of devices have been tried to simplify their construction, and thus cheapen their production.

To this end, the market has been flooded with wrought-iron and steel rim pulleys, and with no end of wood pulleys, all of which lay claim to superiority, but the old style cast-iron pulley with its turned face still holds, and seems destined to hold its own, in spite of all its competition.

In a foundry making a sufficient quantity of pulleys to warrant putting in a set of pulley-molding machines, the calls for double-arm pulleys are very frequent, and the question has often come up whether or not they could be made on the machine, and, if so, at a profit.

The following method has presented itself, and its practicability set forth for the benefit

Fig. 3.



of the craft. It involves the expense of a set of loose arms, such as are used in molding a pulley where the arms are loose from the rim, and an anchor is used, and two cheap anchor rings made in open sand, and light enough so that they can be readily broken after the pulley is cast, and two iron cheeks to match the flasks used on the machine. We will suppose the pulley wanted is 14 inches diameter, 14 inches face, and 7 inches from center to center of arms. Remove the regular half arm pattern and raise the rim one-half the required face, of course allowing for shrinkage, and finish, put on one of the cheeks, and riddle on just enough sand in which to bed in the skeleton anchor referred to as close as possible to the top or face of the machine, and have the lifting screws firmly screwed in, taking care that they will not come in contact with the bars of the cope, which is to be placed on the top of the cheek. The cheeks in a pulley of the dimensions given would be about 4 inches deep, and are rammed full on the outside of the rim and parting made, the inside is rammed up far enough so that the arms can be bedded in midway or $3\frac{1}{2}$ inches from the top of machine, and parting made as usual, the cope is put on, and rammed up, and the screws in the anchor are then taken out and rim pattern dropped clear from the machine, the cope lifted off and the arms and hub drawn, and finished, the core set and cope returned; the draw screws are then replaced, and securely wedged to the cope, and cheek and cope clamped together and both lifted from the machine and carefully turned over on a pair of horses, so that the anchor screws can be taken out, after which they are set on the floor, and you have the first half of the mold. The other half is made in exactly the same manner, only that, as it is the cope, provision must be made for pouring, and that the anchor screws may be left in until the mold is poured.

This, of course, leaves both the skeleton anchors between the pulley arms when cast, and they must be broken out, hence the necessity of making them light and cheap.

If the pulleys are wanted in sufficient quantities to pay, the anchors may be made in what is known as the knock-down style, *i. e.*, to go together with dovetailed joints, and after the pulley is cast may be knocked down and taken out through the arms in sections, and in this way may be used any number of times.

It may seem that considerable rigging is required to accomplish the result, but under the most favorable circumstances a double-arm pulley requires considerable rigging. Pulleys made in this way may have the hubs meet in the center, making one continuous hub, or the hubs may be made independent of each other.

With a rigging of this kind it is a very easy matter to make the pulleys flanged, either on the inside or outside.

When double-arm pulleys are wanted with faces narrower in proportion to the one described above, they may be made by leaving the regular machine arms on, and cheek and cope used same as above, and thus two-thirds of the pulley made in the first cope and cheek and the remaining third made as an ordinary cope on the machine.

There are several styles of pulley-molding machines made by different manufacturers, but the one most familiar with the writer makes from 12 inches to 15 inches diameter in the same size flask, and with the one pair of cheeks described a variation of 3 inches or 4 inches in the face may be made, by making the parting slope up or down as required.

The pulley machine may be utilized in a great many ways aside from making pulleys, such as making rings, arms, spiders, hand wheels, balance wheels, round plates, flanges, etc.

A Historic Furnace.

A press dispatch from Phœnixville, Pa., says:

A historic property known as the Warwick Farm, over near St. Peter's, Chester County, was sold last week. The old Warwick furnace, which is one of the chief attractions of the farm, is conceded to have been the first in the United States to make iron, and was put in blast about the year 1736. At this furnace were cast most of the cannon used in the revolutionary war by the Continental Army. Although it has not been in operation for some years, many of the principal buildings about the furnace are still standing and in a good state of preservation.

In the meadows near by many pieces of artillery lie buried, having been secreted in that way by the managers of the furnace in order to prevent their falling into the hands of the British after the battle of Brandywine in 1777. At that time Gen. Washington retreated with his troops northward through Chester County, thus leaving this important iron furnace exposed to the mercy of the enemy. In 1876 several of these cannon were dug up and sent to Philadelphia as exhibits in the Centennial Exposition. Others have been sent to Paoli, Valley Forge, and elsewhere as relics. The old bell cast at this furnace in 1777, and used in the belfry for many years, is now kept as a souvenir in Independence Hall, Philadelphia.

Practice and Precept.

Miss Gossip—I hear your club had a meeting last night.

Miss Dorcas—Yes, indeed. We had a splendid dinner at Delmonico's that cost $20 a plate, after which our president read a helpful paper on "How to Live on $500 a year."—*Munsey's Weekly.*

When the natural gas craze first began in this country we sounded a note of warning to those who were inclined to so shape their business as to depend entirely upon the supply continuing indefinitely. Just as we apprehended then, the supply is gradually growing less, and manufacturers must continue to go back to coal. Common sense indicated that this must be so.

The Measurement of Power.

By J. J. Flather.

FIFTH PAPER.

Another form of dynamometer, sometimes called the differential dynamometer, was introduced into this country by Mr. Samuel Batchelder, of Saco, Maine, in 1836. The is the governing principle of the Prony brake where the lever is maintained in a horizontal position, the work being estimated as though the weight suspended at the end of the lever rotated in a circle whose radius was equal to the length of arm L. Though alike in principle, the methods by which these two dynamometers operated are radically different. The Batchelder instrument, improved and modified, is now made by the Lawrence

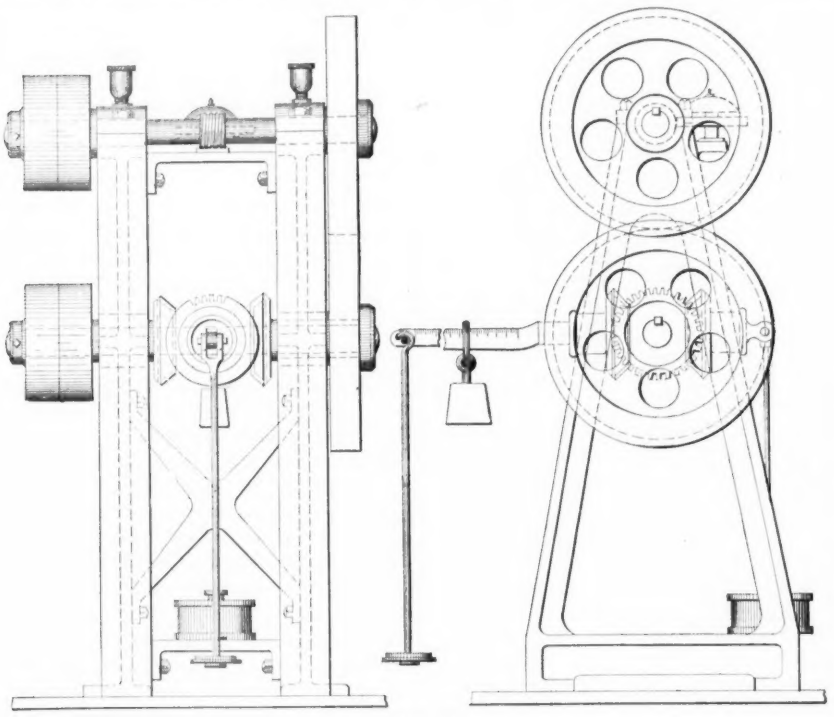


Fig. 7.

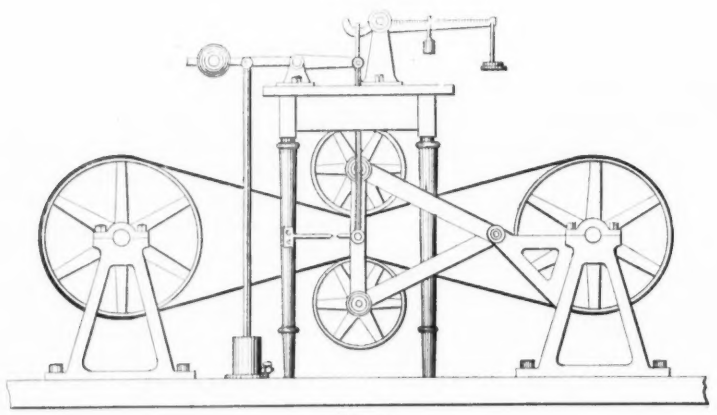


Fig. 8.

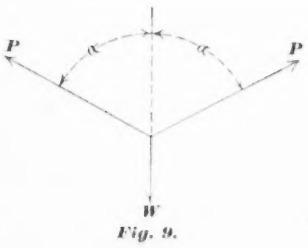


Fig. 9.

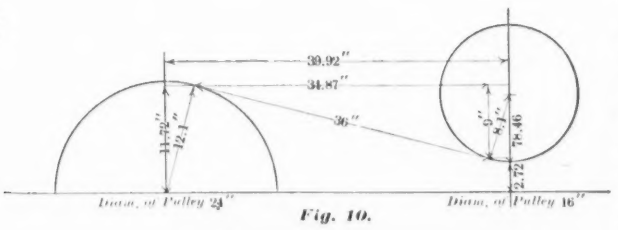


Fig. 10.

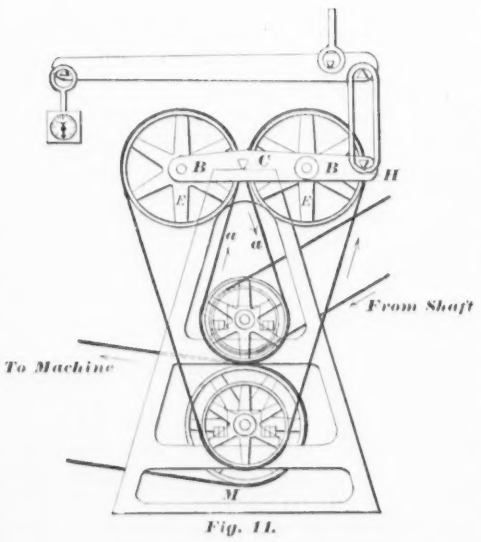


Fig. 11.

Machine Co., and known as the Webber balance dynamometer.

The following description of this machine (see Fig. 7) is taken from a paper, by S. S. and W. O. Webber, read before the Society of Mechanical Engineers.

"On the receiving shaft are fixed a pair of fast and loose pulleys at one end, and a spur gear at the other. This spur gear drives a corresponding gear of the same size and number of teeth, which is fixed on the end of a sleeve or collar, having on its other end a bevel gear, which forms one side of what is known as a 'box' or 'compound' gear. A corresponding gear on the opposite side of the 'box' is fixed on the delivering shaft which passes through the sleeve above mentioned, and also through the fulcrum of the scale beam. The two remaining sides of the box are composed of a pair of equal and similar gears, which revolve freely around the scale beam on either side of the fulcrum.

"One would really be sufficient for the purpose, but a pair is used in order to preserve a balance. When motion is given to the shafts by means of a belt to the receiving pulley, the intermediate gears revolve about the scale beam without effect; but when a belt is carried from the delivering pulley to the machine to be tested, the resistance causes the intermediates to act with the effect of levers on the scale beam, and would put the latter in revolution about its axis or fulcrum, if it were not restrained by the weights, which are to be added, and adjusted until a balance has been obtained. It will be readily seen that the real motion of the scale beam, were it free to move, would only be one-half that of the shafts, and the weights in actual use are therefore double their apparent value, or in other words the weight marked 1,000 pounds is in reality two pounds instead of one."

The circumference of the circle through which the weight would travel, were it free to move, is ten feet, therefore we can readily calculate the horse-power from the following:

$$H.\ P. = \frac{P\,v}{33{,}000} = \frac{P \times 2\,\pi\,R\,N}{33{,}000};$$

since $2\,\pi\,R = 10$, we have

$$H.\ P. = \frac{10\,P\,N}{33{,}000},$$

in which, as in our former notation, P = pounds weight, N = revolutions per minute, and v = velocity in feet per minute.

The weights are marked for $N = 100$.

Another form is that known as the belt dynamometer, used by Dr. Hopkinson in his tests with the Siemens dynamo-electric machines.

The principle involved is the weighing of the resulting stress from a deflected belt, and by this means ascertaining the direct stress upon the belt itself.

As previously intimated, the power exerted by a belt is the difference of strain on the two sides of the belt, multiplied by the velocity of a point on the belt. A belt connecting two shafts, when at rest, has the same tension in all its parts, but as soon as work is performed by the belt this uniform tension ceases, the driving shaft exerts a pull on the driven proportional to the resistance overcome, and as the adhesion of the belt is brought into play, one side—that on which the pull is exerted—is tightened while the other is correspondingly slackened.

To obtain a measure of this difference in belt strain, the dynamometer shown in Fig. 8 has been designed by Mr. Robert Briggs.

In this arrangement it is evident that when at rest or running with no resistance the system will come into equilibrium with equal but opposite angles for both the lower and upper belt—provided the weight of the carrier pulleys, the frame supporting same, and the weight of the belt are balanced. It can be shown that the resultant of strain from the deflected belt varies as the cosine of the angle which the belt makes with the vertical, or $W = 2\ P\ cos\ \alpha$, Fig. 9; therefore, if we make the angle 75° 31′ the cosine will equal 0.250, or

$$cos^{-1}\ \tfrac{1}{4} = 75°\ 31'.$$

Let $cos\ \alpha = .25$; tension on tight side of belt $= T_1$; tension on slack side of belt $= T_2$; weight $= W$; force transmitted $= P$; then will $T_1 - T_2 = P$. Now, since $W = 2\ P\ cos\ \alpha$, and $cos\ \alpha = 0.25$, we have $W = 2\ P \times \tfrac{1}{4}$, hence

$$P = 2\ W.$$

If, therefore, a weight w be applied on the scale beam so that it exerts a force W, acting downwards, there will be transmitted by the belt a force $P = 2\ W$, in order to maintain the system in its central position, and this force is a measure of the driving power of the belt.

Accepting these relations of angles and force, the following diagram, Fig. 10, will show the relative positions of the arrangement employed. An allowance of $\frac{1}{10}$ inch has been made for half the thickness of belt when the radii of the line of the belt on the two pulleys become as shown 8.1 and 12.1 for the 16 and 24-inch pulleys respectively.

Note.—In a series of experiments on leather belting made by Wm. Sellers & Co. in 1885, it was shown that the sum of the belt tensions is not constant, but increases with the load. This is contrary to the generally accepted theory that the sum is constant, but subsequent experiments have shown that the total tension actually increases as the difference increases, whether the belt be horizontal or vertical.

A modification of this dynamometer was designed by Prof. Elihu Thomson, in which the angle α was made equal to 60°.

Another form in which the difference in tension of the slack and driving sides of the belt is exerted to vibrate a system of lever arms and scale beam is that proposed by Mr. W. P. Tatham; Fig. 11 shows the general arrangement of this apparatus. The belt from the shaft drives the dynamometer in the direction indicated by the arrows, a and a' being respectively the tight and loose belts, or rather sides of the belt, driving the pulleys E and E' on vibrating frame B. These belts do not pass through the fulcrum C, but their direction does. The vibrating frame B is balanced upon knife edges at C, and is provided with similar knife edges at H, which engage the links of the scale beam.

The distance from C to H is equal to the effective diameter of the pulleys E and E' upon the vibrating frame; a pulley M keyed to lower shaft communicates motion to the machine to be tested, the direction of belt being as shown.

Apprentices—Notes on Pumps.

By W. H. Booth.

Mr. Rogers' Sketches of an Apprenticeship bring to mind a little episode of an apprentice which I cannot resist giving to the readers of the American Machinist before going on to speak of something more serious.

In the shops of a certain English railway there are three classes of apprentices. I will describe these, beginning at those who probably learn the most during their apprenticeship, and this, too, with the least facilities for acquiring knowledge.

Class 1 consists of those who pay no premium, but go into the works as ordinary trade apprentices, either because they wish to do so or because, having lived all their life in a town where the railroad shop is the town, and swallows up all other interests, there is no other pursuit open to their range of vision.

Class 2 consists of premium apprentices who pay for the privilege of making themselves as greasy as they please, and of being passed through several shops, and acquiring considerable information if they choose to do so.

The third class is small and select, and consists of seven young gentlemen, who, for an annual payment of about $500 a year to the chief mechanical engineer of the line, are accorded the privilege of doing as they like, and going to any part or room of the works to which their fancy may take them. They are said to become proficient in practical joking, and not to be above dropping a fog signal down a stove pipe of a brake car if any one is making themselves too comfortable inside.

To prevent disappointment the apprentices of Class 2 are allowed to come a month on trial before planking down the cash.

One such probationer on first arrival was taken as usual into a certain shop where all of his class were first started to earn dividends for the company as compensation for having paid a premium. His get-up was unique, for he was attired in top boots—or simply boots I suppose I should say, to be understood on your side. They were riding boots, as a fact. On his head was a sou'wester hat, with back flap like any ancient mariner. Needless to say, his appearance at once created a sensation; every worker in the shop vigorously belabored the most sonorous piece of metal at hand, and quite a tin kettle concert was commenced.

The shop foreman—a small, precise-speaking man—took the embryo engineer to a tap-fluting machine, with all its oil-swilling tackle in order, and before it stood the novitiate, hands in pocket.

"What is this damned thing, anyway?" he demanded.

The little foreman explained: "You will please work at this machine until you can do the work properly, and I will then move you on to another machine."

The reply came, "I'll be shot if I do—the filthy machine isn't fit for a navvy to touch."

With that he turned on his heel and marched out, his souwester flapping on his back, and was seen no more, mechanical engineering not commending itself to him.

Some readers of the AMERICAN MACHINIST will not fail to recall this scene.

In an artesian well it is often claimed that the pump can be attached directly upon the bore pipe without the use of a separate suction pipe dipping into and surrounded by the water in the bore pipe.

Suppose, for example, the pump stands directly upon the top of the well tube, and that the water stands in the tube when at rest within twelve feet of the top of the tube. When set to work with a suction pipe, as in Fig. 1, the water sinks a further four feet, at which the well flows at such a rate as keeps the pump supplied.

Now the total lift or suction being now 16 feet, it may be argued that, as the pump will lift 24 feet if in reasonable order, it might just as well be coupled upon the bore pipe direct, without an inner suction pipe. Thus,

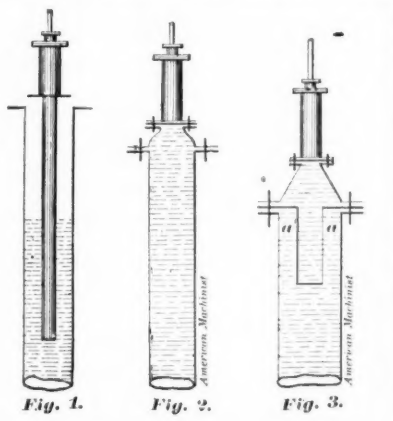


Fig. 1. *Fig. 2.* *Fig. 3.*

Fig. 2 would represent the case of direct attachment. It is even argued at times that thereby the yield will be much increased. This contention I am not prepared to deny, for it is probably a fact in certain cases, but it is by no means universally true.

If a pump connected as in Fig. 2 were pumping out of a very free and copious supply, as from a rocky stratum full of fissures, then the bore pipe itself partakes of the character of the inner suction of Fig. 1, and the yield may be as much or more than if a smaller inner suction pipe were used.

In the case, however, of a well bored into a weak supply, I have found a better yield to be obtained when a separate suction has been employed. There are good reasons to explain this. Assume a single-acting pump. When it is on its suction stroke it must draw from the bore pipe a barrel of water at each draw stroke. If arranged as in Fig. 1 it can do this easily; for, should the well not be yielding at the rate of draught, then the water level in the bore pipe will fall somewhat during the suction stroke of the pump, and will rise again during the down stroke. The well is kept in a constant state of flow, and keeps the pump fully supplied at each stroke; for, though not flowing at the rate of draught of the pump, this latter is not drawing more than half its time, during the other half of which the well is making up the deficiency.

Now if attached, as in Fig. 2, without a suction pipe, the flow of the well being at a less rate than the draught capacity of the pump, the pump barrel would only fill partially during its stroke, and it is obvious that, the well pipe being full of water to its very top, there can be no further flow of water up the bore during the half time of the pump when the down stroke is being made, for there is nowhere for the flow to store itself. Further, there is the possibility that the bore pipe may be drawing air unknown and imperceptibly, whilst with separate suction this is easier found out, and cannot occur below water line, as it can with the bore pipe used as suction.

In a recent test of a pump connected first as in Fig. 2, and afterwards as in Fig. 1, there were readily obtained 14 gallons of water with the latter arrangement as against only 11 gallons as before, no other changes being made than the change of suction.

Of course the foregoing remarks are more especially applicable to single pumps.

Double-acting pumps or double and treble-barreled pumps in which the draught is more nearly constant and continuous, do not check the flow of water up the bore pipe in the way single pumps do, and may be directly connected with less loss than a single pump.

If, for any reason, a separate suction could not be placed down a bore pipe—I can imagine situations where one might be inadmissible or inconvenient—then a vacuum chamber might be arranged, the action of which, like its parallel, the air vessel, would be to keep up a draw on the flow of a well during the down stroke of the pump, and give out the supply thus stored during the draught stroke. Such a vacuum chamber may be arranged as in Fig. 3. In this arrangement there is a very short inner tube which creates an annular chamber *a a*. The "vacuum" in this chamber is commensurate with the depth from which the water is drawn. This vacuum chamber affords a reservoir, the surface of which can fall when the pump draws more water than flows up the bore pipe. The "vacuum" in *a a* keeps up a draught on the water when the draught of the pump ceases, and this may, as compared with an extreme case of Fig. 2, nearly double the yield of a well. It allows the well to flow continuously, in fact, which is impossible with Fig. 2. Hence the benefit to be derived by Fig. 1 arrangement.

Fig. 3 should really afford the best results in practice. Fig. 1 becomes Fig. 3 if the bore pipe is sealed tight at the top, the suction passing through a top flange, and secured by an air-tight joint.

I would invariably advocate double or treble barrel pumps if I wished to secure the largest possible yield of water from a sluggish bore hole in order to prevent the intermittent flow of water which must occur more or less with a single pump, even when arranged as in Fig. 1.

If a well, connected as in Fig. 2, is found to yield as much water as the pump is nominally able to supply when figured out on its capacity, then it may be taken that the well is capable of yielding very considerably more than is being asked of it if it is only put into a position of being able to flow continuously, as in Fig. 1 or Fig. 3.

A recent experience of which I wrote, of a suction pump without a proper suction bucket, strongly confirms the necessity of not entrusting pump work to any one not accustomed to pumps. Where for months the pump had given a miserable yield of only three units, it is now yielding over eight units; but, correspondingly, where five units was stated as being a supply which would be thankfully received, the demand, when over five was given, rose to 10, and, later, "if you *could* give us twelve we could do with it," is now the expressed wish. The same pump which gave three units, and would not draw fifteen feet, now gives over eight, and draws twenty-one feet at that.

To get the twelve units wanted means, of course, placing the pump lower down, as it should originally have been placed.

A little more knowledge and care would have saved all the trouble and dissatisfaction, and hundreds of dollars.

Reform in Boring Tools.

BY A MECHANIC.

Some years ago, while working in a jobbing shop, a shopmate had occasion to get up a boring tool in a hurry. I met him when coming from the blacksmith shop, and he showed a tool like Fig. 3. He said, "I didn't have time to get one drawn out, but as the hole I am going to bore is quite large, I guess this will do. I guess the blacksmith did not understand me very well, for he made this upside down."

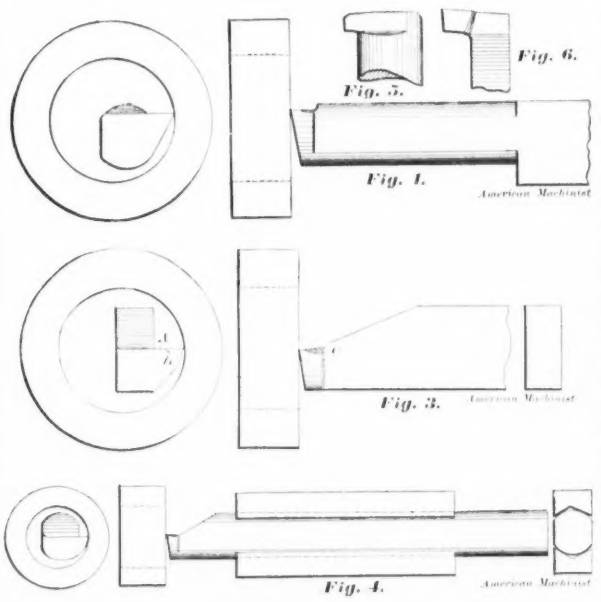
That "upside down" tool did do his job all right, and also a great many other fellows' jobs, who were lucky enough to find it not in use.

In Fig. 1 we see the style of boring tool most in use. Of course when boring a small hole we have to use a tool that will go in that hole, but there is no excuse for making all boring tools like Fig. 1; Fig. 3 will bore quite a small hole when made of the same size steel as the usual turning tools. Of course, if we have the point of tool about flush with the top of body, as in Fig. 1, and made in the usual way (the idea the shopmate must have had when he spoke about "upside down"), we could not then use it as I show in Fig. 3. Theoretically I suppose it would not make any difference whether the point of tool is the same height as the center or not, provided that the line *A* (in Fig. 3) is kept radial, and the angle *B* is kept the same, but practically I believe most lathes work best when the tool is as shown in Fig. 3.

Most shops do not have a great variety of boring tools, and so when the kind like Fig. 1 are used, a great many times a job that will admit of a short tool has to be done with one a great deal too long and slender.

In Fig. 3 the tool can be either long or short at will, by just pushing it through the tool-post. I believe that tools like Fig. 3 and Fig. 4 will cover the whole ground. Fig. 3 is as stiff, probably, as the lathe will carry, and is just as stiff as Fig. 1 would be if the rounded part had twice the stock in it that the part that goes in the tool-post has. No part of the tool need be stronger than its weakest place, and as we cannot exceed a certain size steel (provided we use the tool-post), then Fig. 3 is as stiff as we can use.

For small holes Fig. 4 is the best rig I have ever used. We can use different sizes of steel for tools, and cover all sizes that Fig. 3 will not.



I wish to say a few words about the shape of the point of boring tools. Fig. 5 is the form used when a man finds it necessary to get his lathe to bore a taper of about $\frac{1}{4}$" to the foot, when trying to bore a straight hole. That round point is a great help to make the tool crowd away from its work.

I find that a point shaped like Fig. 6 works well. I just take the sharp corner off the point.

Sometimes when boring a long hole in cast-iron where there is scale, a tool with quite a radical hook ahead will hook under the scale and keep to its work, where one with a round point would spring and crowd away. I like to have quite a good top rake on a boring tool, especially when boring wrought-iron. In some lathes we could not get a tool like Fig. 3 high enough.

When there is no adjustment that will allow of this height being reached, and the slot in tool-post is not high enough to allow the tool to be blocked up, it is a fault of the lathe, and ought to be remedied.

I have found many lathes where the cross-screw was so short that the tool-block could not be moved to the center without running off the screw. With such lathes it is necessary to have an offset in a boring tool, which is a nuisance. It seems to me that any one who is competent to build lathes ought to make such screws long enough.

There is a growing intention on the part of railway trainmen to demand shorter hours. This is a move in which the public is interested. It ought to succeed.

As Fine as Silk.

"As fine as silk" is a common phrase to typify extreme fineness or delicacy of texture. But if you want a simile that will discount that one, say, "As fine as a spider's web." There is nothing of textile kind so fine as that. The strand spun by a spider is as much smaller than a thread of silk as the latter is smaller than a telegraph pole. This seems like exaggeration when you casually look at the spider's workmanship and then at the silkworm. But you never saw a single strand in the spider's thread. The strands are so fine that you couldn't see them with the naked eye. What you really see when you look at the spider's delicate thread is a cable composed of thousands of strands, and the way the little animal makes this cable is one of nature's greatest wonders.

If you look closely at a spider during its business hours you will see that its thread comes from a circular spot near the extremity. In this spot are from four to six knobs, the number depending upon the kind of spider. If you happen to have a particularly good pair of eyes you can distinguish these knobs. Each of the knobs is full of minute holes, so small that a good microscope is necessary in order to see them. Through these holes the delicate strands are spun. About an eighth of an inch from the holes the strands are joined together, and the result is the spider's thread, with which all of us are so familiar.

And the little spinner attends to business as closely and as carefully as does the weaver of the finest silk fabric. It has on each foot three claws, one of which is a sort of thumb, while the others are toothed like a comb. These claws are constantly used to help to keep the strands from tangling before they are joined in the thread. The material from which the thread is made is secreted in the animal's body. It is a glutinous substance, and the strands dry while they are passing from the little apertures to the point where they are joined together. One authority on this subject, Reaumur, calculated that it would take 1,000 spider strands to occupy a space equal to the point of a needle, while another, Leuwenweck, estimated that it would take 4,000,000 of them to make a thread as large as a hair.

But while the spider's work is the more delicate, that of the silkworm is the more useful. Nearly half of all the people in the world live in China and India, and all of them, except the very poorest, wear silky goods as commonly as we wear cotton. As it takes the labor of nearly a thousand silkworms to make one pound of silk, you can see what an enormous industry results from this tiny thread spinning. Unlike the spider, whose spinning works are at the lower extremity, the silkworm's factory is near its mouth. The crude material is seemingly much alike in the two classes of spinners—a gummy or glutinous pulp. The spinning appurtenances, however, are entirely different, the silkworm making only two strands for its thread, while the spider makes thousands.—*Pittsburgh Dispatch.*

In the instance of a recent railroad disaster, by which several persons were severely injured, it was recommended by a coroner's jury that the railroad company be "severely censured." Seems to us we have heard of similar verdicts before. No doubt the soul of the great corporation—if it had one—would be rent with sorrow. Seriously, such recommendations by a coroner's jury savor of nothing so much as silliness. They do harm rather than good. Let such juries occasionally recommend indictments for manslaughter, and let their advice be acted upon, and something tangible will be accomplished.

LETTERS FROM PRACTICAL MEN.

How He Bored the Cylinder Head.

Editor American Machinist:

Brought up on a farm, and trudging to the "city," selling eggs at four cents a dozen, and dressed geese at ten cents each, seemed a slow way to make a living; and getting glimpses into an open machine shop door in the suburbs set me thinking. The more I thought, the more uneasy I became to know the mysteries of the shop—especially after I had picked up at the door some curious curled up *shavings of iron*. I had never seen a lathe, and when told that that was the name of the machine that made the shavings, I was determined to know all about it.

Dressed in my best homespun, I sought the proprietor, who cooled my ardor by saying, "No! We don't want a boy. There is no profit in boys. They break more than their necks are worth." Going home with a heavy heart, I met a friend who told me that I could get into this same shop if I could get a recommend from a man who owns a large mill in the vicinity.

I saw the mill owner, got a note, and appeared at the shop next day. The proprietor met me at the door, read the note, looked cross, asked me if I were not the boy whom he told the day before he had no place for, and ended by saying I could try it, but expressed a significant doubt as to my liking it, and ended by turning me over to the foreman—which position then meant more than it does now—with the ominous remark, "Put him in the blacksmith shop." This was not what I expected, and was evidently meant to discourage and drive me off; but the bright wheels of the various tools in the machine shop, of which I got encouraging glimpses, made me forget blistered hands and burnt clothes, and I held bravely on through six months sledge swinging.

I got various opportunities to forge small jobs, and, before the close of my blacksmith probation, was promoted to a fire as tool dresser.

Right here let me say that the blacksmith's shop is the best place to begin the machinist's trade in, and the young man who dodges that will leave out something which he will want a thousand times before he gets through.

The success of the note gave me my first lesson in diplomacy, and I mentally argued that if I was taken in to please the mill owner, I might make myself so useful that I would be kept for other and better reasons.

That is just what happened; and I would say to apprentices—and even some journeymen—that that is just what will happen—*if you work for it.*

Promoted to the machine shop and a lathe—not one of the best, but a lathe—wooden "shears" V top, rack and rod feed—I was given as a first job a cylinder head to bore the stuffer and fit the gland. There was no drawing, nothing but the castings, and the foreman's order to "divide the difference and bore out as much as you take off."

I had a fair common school education, had been through decimal fractions, and with a piece of chalk figured out the size, but found it ran into a long string of decimals which my rule said nothing about, so I compromised on 3¼ inches as being nearly right. I chucked the head—fairly covering it with chalk marks put on and wiped off many times before I got it true. I got on fairly well with the boring, until the tool struck a ridge at the bottom of the stuffer, and threw the job out of the lathe. Amid the taunts and jeers of apprentices, and grins of the "jours"—one of whom kindly told me the job lay "on the floor under the lathe"—I chucked it again, dressed the broken tool, and by taking short cuts "by hand," worked the ridge out, and—the lathe having a swivel head—finished the stuffer—a good straight hole 3¼ inches *clear through.* I took the job out, and set it up in the vise where it would be handy to caliper—as I said—but mainly so all could admire the smooth, straight hole I had made on the first trial. Men and boys gathered around the job, looking through the hole, and just shouting. The noise attracted the foreman, who looked through the hole, and shouted like the rest, only he added a big swear word at the end of his shout.

All this time I was standing back with my arms folded, modestly taking all this applause as my just due. The foreman sobered down, told me that one was finished, and to chuck another, and he would tell me something when I got ready to bore.

When ready, I called him, and he said, "Do you see that collar in the bottom?" "Yes," I said, "there was a big ridge like that in the other one, and I had a job to bore it out."

He then did what he should have done in the first place—explained the use of the ridge. This gave me a valuable lesson in handling apprentices, the moral of which is, "Do not expect an apprentice to know anything until he has been told at least once, and do not be too sure of it then."

BENJ. F. WILSON.

Improving a Wire Gauge.

Editor American Machinist:

From time to time I have read with pleasure, in the AMERICAN MACHINIST, descriptions of ingenious and useful tools, but I never have seen any reference to the ordinary wire gauge with any startling improvements attached to it. I beg, therefore, to send a suggestion to brother mechanics who have frequent use for the wire gauge.

Some years ago I had constant use for a Brown & Sharpe standard gauge in the purchasing and assorting plate metal, but was obliged to work such plates in thousandths, thus necessitating the use of a micrometer gauge for the readings, so, after satisfying myself that my slit gauge was perfectly accurate, I etched the size of each number on its face, and was enabled to discard the micrometer altogether. To stamp or engrave such figures upon a finished gauge will not do, because it will spring the gauge, but it is a simple matter to scratch through a thin film of wax, or etching varnish, with a fine tool or pin.

This sketch shows exactly the gauge that has given me immense satisfaction for many years. O. C. WOOLSON.

Newark, N. J.

[We do not reproduce the sketch spoken of by Mr. Woolson, because we think none will fail to understand the matter from his description. We may say, however, that the gauge is that known as the American standard wire gauge, a cut of which appears on page 187 of the small catalogue of Darling, Brown & Sharpe, the sizes of the different numbers of the gauge for No. 5 to 36 being given in decimals in the second column of the table, page 198.—ED.]

Critical Notes—Engine Wreck—Unlimited Job Work.

Editor American Machinist:

Mr. Bullock, describing the Corliss engine wreck and suggesting the possible cause of it, does not mention in what manner the governor was driven—whether by belt or a positive motion by gearing.

Most of the Corliss engines have governors driven by a belt, and when such is the case I think if the governor belt is broken or thrown off the pulley the engine will run off, because the valves will remain open full stroke, the releasing gear being rendered inoperative. It is difficult to imagine anything else that could happen to the valve gear which would produce such destructive results. I may be in error in regard to this, but I merely offer it as a possible explanation of what happened to the valve gear.

I am always interested in anything that is accomplished under difficulties by the exercise of ready ability, and Mr. Rogers' description of the manner in which his foreman made a shop of unlimited capacity from one of limited size calls to mind some of Chordal's stories of what has been done in the backwoods by the untutored and original western mechanic.

It seems that about all that is needed to make a large pulley is a shaft, a couple of gear wheels, and enough real estate to swing it on.

In the early mining days of Leadville, Col., an Ohio machinist was sent there to erect some machinery, and while there the mine owners found it desirable to have a large pulley bored to a larger diameter, so it would fit another shaft, but, to their dismay, it was found to be some hundreds of miles to the nearest shop having a lathe large enough to bore it.

At this juncture the machinist offered to bore it out, if they would furnish him what help he wanted, for the sum of fifty dollars. They accepted, and he went to work. He procured a piece of old turned shafting, to serve as a boring bar, and mortised it to hold a tool. The pulley was placed in a horizontal position on some blocks, with the axis vertical. A plank was placed on each side of the rim, passing directly across the hub, and secured to the rim by bolts through the planks inside the rim. Just opposite the bore, holes were cut through the planks a little larger than the boring bar. The bar was placed in position and trued up by the wheel rim and held there until babbitt was poured in the holes in the planks to form bearings for the bar. A thread was cut on a bolt a little longer than the pulley hub to serve as a feed screw. Two pieces of scantling were notched and bolted together to form a clamp nut for the feed screw, and this was placed under the pulley hub on the ground, over a hole that was dug to allow the screw to pass down through. The head of the screw rested against the lower end of the bar, and enough friction was applied by the clamp nut to keep the bar from turning it. To the upper end of the bar a lever was clamped of sufficient length to reach beyond the rim of the wheel, and to this the motive power was applied, the same being a couple of Mexicans who tramped around in radial horse-power style to the music of master mechanic's whistle, who, after setting the cutting tool, went under the pulley with a monkey wrench and attended to the feed works. It is needless to say that he did a good job.

Another creditable job he did was on an engine fly wheel, one segment of it having been broken while in transit. Another segment was made at the nearest foundry, and when placed in position it was found to be too thick in the rim, making it larger in diameter. After fitting it in place in the wheel on the engine shaft, he rigged up block and tackle to partially rotate the wheel back and forth the length of the segment; and with a piece of shaft as a guide for the tool-holder, and a couple of set-screws to feed with, he turned off the segment to match the rest of the wheel. BELL CRANK.

Points About Grinding Operations.

Editor American Machinist:

The solid emery wheel is believed to be indigenous to this country, and is more extensively used here, and for a greater variety of work, than anywhere else. But there is one adaptation of it in use in England which I have not seen used or published in this country, a machine for grinding accurate cylindrical internal surfaces. The machine comprises three motions, viz., a rotary motion in the usual way, a gyrating motion whereby the revolving wheel is made to travel around the center line of the cylinder being ground, and by which means the cutting point of the wheel is made to travel over the whole internal surface, and an endwise feed motion. This machine is capable of doing the most accurate work, and may be adapted to almost every kind of work; I believe it is patented in that country, but it is none the less worthy of being adopted here.

It has heretofore been a difficult job to grind the joint face of an overhanging steam engine cylinder to its bearing on the bedplate, but through that necessity which is the mother of invention I have discovered a convenient way of doing it. A ring of the same diameter as the cylinder, having a cross in it with a hole in the center, is fitted to the bedplate in lieu of the cylinder. This ring is held to its place by a rope through the center hole, and made fast at the other end of the bed-plate, giving an elastic pressure to the ring which is free to revolve, oil and emery being applied in the usual way.

The cylinder face is ground by its opposite head, and, both faces being true, the joint is tight just the same as if ground together.

Among the numerous grindstone items in the AMERICAN MACHINIST, I have not seen the old plan of running two grindstones together, in contact, at different speeds, or in different directions, whereby they keep each other true. But whatever way the grindstone is used—if intelligently used—its popularity is likely to hold good. When such shops as Brown & Sharpe's continue to use grindstones, other shops may follow suit. In our little shop we have used an emery wheel tool grinder—one of the best—with tolerable satisfaction. Last week, the wheel being worn out, I substituted a grindstone, and it makes the boys laugh when they have tools to grind. It wears away faster, certainly, but it only cost a couple of dollars, while the emery (or corundum) wheel cost twenty, and it cuts with a vim, reminding us of the old times. It seems as if the old-fashioned way is the best, after all, and if grindstones were always as well mounted as emery wheels in the same kind of machines, and powerfully driven by wide belts, large pulleys, countershaft with tight and loose pulleys, and shifter with proper changes of speed, and kept true, the emery wheel would drop out of sight. Their worst feature is their consummate dirtiness; but a good machine, plenty of water and frequent cleaning will take care of that.

An examination of the tool board of an average lathe man, when left to his own sweet will in the choice of tools, develops a condition of things that is anything but encouraging. The queer lot of things he works with and calls tools indicates a deplorable lack of intelligence. Like the contents of a small boy's pocket, there is about everything there that is useless. But the phenomenon of good work being done with these implements is even more marvelous than the tools themselves. It is hardly fair to judge a workman always by his tools; some good workmen use very bad tools, and some others use tools that nobody but themselves would tolerate, and still others get ahead of their class by using good tools and brains together. C. W. CRAWFORD.

Brazil, Ind.

Sketches of an Apprenticeship.

BY W. S. ROGERS.

Johnnie had been on the small planer for nearly five months, and was able to get his work through with a rapidity equal to many of the older ones in the shop. So one day he quietly explained to the Old Man that he felt entitled to a change, and would like to get on a lathe. The Old Man took his complaints in good nature, telling him that in good time he should be promoted, and not to get overanxious, nor try to get on too fast, as too much go ahead would spoil a boy as well as too much holding back. In fact, it is a little worse, he thought, as it tended to make him conceited, and a conceited boy generally grows into a silly, bragging, big-headed man.

As Johnnie told the other cubs at the noon hour, they laughed, and many were the jibes and jokes at his expense for getting too fresh with the Old Man. But a few days later, when the foreman told him to clean up the eighteen inch lathe over in the corner, the boys gave him credit for doing things about right, for when a cub got orders in that shop to clean up a machine, it had only one meaning, and that was "step up," and inside of two hours every boy in the shop had spoken to the Old Man for a promotion except one; that was Dick. He had been on a lathe for about three months, and I'll not soon forget how wise he looked when he told us to wait and see how he approached the boss. We waited and watched. Next day he buttonholed the Old Man in this wise: "Mr. Smith, I've been on this lathe for three months; I can turn out as much work and as good work as any jour in the shop, and I don't think it is right or fair that I should receive only three and one-half dollars a week, while the jour gets two and a half dollars a day. Now I want jours' wages,

or I'll go some place else where I can get it."

The Old Man listened patiently to his story, and after he had ended, he asked: "Do you really mean what you have said? Have you thought over carefully what it means?"

"Yes, I've thought over it a good deal, and I'm right," replied Dick.

"All right," answered the Old Man, "you had better try somewhere else," and he walked away looking kind of sorrowful. That night Dick bid us good-by, saying he was "no three and a half cub," while we admired his "courage."

Time has since shown me that we cubs did not understand. Dick did get another job, and he is to-day a $1.75 a day lathe hand, nothing more, and he never can be, while Johnnie is a mechanic, and is sought after on all sides because he learned to be a master workman.

I can understand now why the Old Man looked sorrowful when Dick solved his own future.

Odontics, or the Theory and Practice of the Teeth of Gears.

BY GEO. B. GRANT.

NINETEENTH PAPER —CONCLUSION.

176.—HERRMANN'S LAW.

Herrmann gives a law, and claims it to be universal, to the effect that the skew bevel tooth must be swept up by a straight line generatrix that is always parallel to the directrix. He mentions the Olivier tooth, and claims that it cannot be correct, evidently not understanding that Olivier's theory clearly includes the form he himself proposes. His form of tooth, claimed to be the only possible form, is really only the best form of the Olivier tooth.

We will not undertake to state wherein Herrmann's law is incorrect, but that it is wrong is clearly shown by the most convincing of all proofs, the reduction to practice. Beale, for the Brown & Sharpe Mfg. Co., has made working Olivier gears on a large scale, which are directly contrary to Herrmann's law, but which work perfectly, and demonstrate the truth of Olivier's theory in a way that admits of no question.

Indeed, the closest possible scrutiny of Olivier's theory, without the aid of Beale's experimental work, fails to detect a flaw in it. Herrmann's condemnation of it is not based on direct consideration, but simply on the fact that it does not agree with his own law.

177.—BEALE'S SKEW BEVEL GEARS.

Beale's gears are the same as Olivier's gears in general theory, but the improvement in practical form and application is so great that they may be considered a distinct invention.

Fig. 161 is a section through one axis, and at right angles to the other axis of a pair of

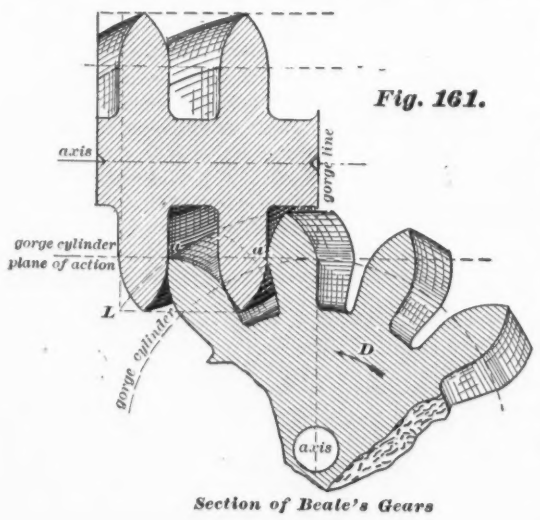


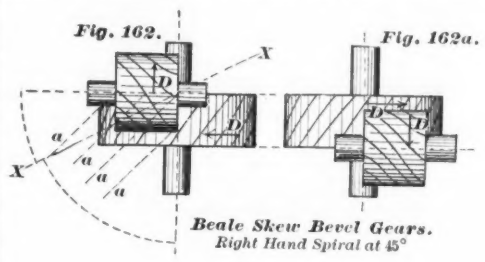
Fig. 161.

Section of Beale's Gears

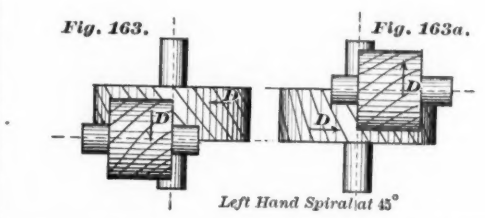
Beale gears. Both surfaces of the teeth are true Olivier spiraloids of Fig. 159, and the gears will run in either direction. When corrected for interference they are reversible, like spur or bevel gears. The gorge cylinders are tangent to each other, and are so cut away inside as to allow the teeth of the mating gear to pass.

The Olivier theory requires the teeth to vanish at the gorge, as shown by the single full tooth of Fig. 160, in order to pass, while the Beale gear is cylindrical in form as a whole, and passes the full tooth at the gorge, with action over its whole surface. The difference is practically very great.

When in action a pair of uncorrected Beale gears must be placed as shown by Figs. 161 to 163, with one end of each at the gorge, and they will not run together if placed at random. If either gear extends beyond the



Beale Skew Bevel Gears.
Right Hand Spiral at 45°



Left Hand Spiral at 45°

gorge line there is an interference between the involute spiraloids which is the same in kind as that between the involute curves of common spur gear teeth.

Each gear can drive in but one direction, depending upon the position of the gear and the direction of the spiral, and if turned backwards the action is intermittent and practically useless. The gears must be placed as in Fig. 162 for right-hand spirals, and as in Fig. 163 for left-hand spirals, and the direction of the rotation is shown by the arrow *D*, when the gear bearing the arrow is the driver.

But, if the direction is to be reversed, the gears can be arranged as in Fig. 162*a*, or as in Fig. 163*a*. This resetting is the same in effect as turning the gears half around, except that opposite sides of the teeth are in contact in the two positions of the same gears.

If, however, the interfering parts of the tooth surface are removed, the gears will run together perfectly and in either direction when put together at random.

In the cases shown by the figures, the spirals make the angles of forty-five degrees with the shafts, contrary to Herrmann's law, but the action will be smoother, and the sliding of the teeth on each other will be less, if Herrmann's angles are adopted. These angles are the same as those made by the conical face of common bevel gears of the same proportion with the axes, and the best angles for the two-to-one proportion of figures are those of the line *X* of Fig. 162, making the angles 26° 34′ and 63° 26′ with the axes.

The Olivier gear of Fig. 160 is perfect in theoretical action, but the teeth must be taken so far from the gorge that the obliquity of the action is excessive, and the arc of action is so limited that the teeth must be small. The sliding and wedging action is so great that the gears are practically useless.

In comparison, the Beale gear is taken so near the gorge that it is practical and serviceable, having large teeth and small obliquity.

The working length of each gear is as determined by the line *L* of Fig. 161, and the whole surface of the tooth within that limit will be swept over by the line of contact. If the length of each gear is equal to the radius of the other gear it will always be long enough.

The action between two gears will be at the straight, equidistant, parallel lines *a a*, Figs. 161 and 162, in the plane of action tangent to both gorge cylinders.

The shafts of a pair of skew bevel gears should be as near together as possible, just far enough apart to allow the shafts to pass, so as to avoid the excessive sliding action. In that case both Beale and Olivier gears are practically useless, the former on account of the small size of the teeth, and the latter on account of the great obliquity of the action.

The common bevel gear becomes the spur gear when the shaft angle becomes zero, but the analogous transformation of the skew bevel gear into a bevel gear by reducing the gorge distance to zero is not possible.

The skew bevel gear becomes a spur gear if we imagine the axes to be brought parallel by removing the gorge to an infinite distance, for the spiraloids on the gorge cylinders then become involute surfaces on base cylinders. But, and it is a curious circumstance, when the shafts are brought parallel by imagining the shaft angles to become zero without changing the position of the gorge, the gorge cylinders become tangent and the gears do not become spur gears.

Involute skew bevel gears do not appear to have any possible adjustment corresponding to the adjustment of the shaft distance of involute spur gears, or of the shaft angle of involute bevel gears, (56) and (157).

Beale's gears are fully described in THE AMERICAN MACHINIST of Aug. 28th, 1890.

178.—TWISTED SKEW TEETH.

As no two surfaces of reference attached to a pair of revolving askew shafts can be made to coincide with each other, like the planes of spur gears or the spheres of bevel gears, the twisted or spiral tooth is impossible, for such a tooth would not permit the required sliding action.

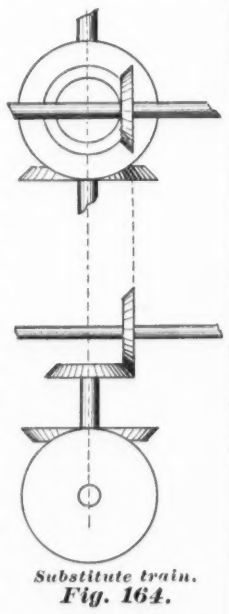
But, if a line is drawn upon one pitch hypoid of a pair, a corresponding line may be drawn upon the other, as if the given line could leave an impression. Therefore a tooth having edge contact (100) may be constructed, provided the twist is such that one pair of lines always crosses the directrix. These teeth are purely imaginary, but if the edges are thick they will have an action upon each other, at a single point of contact, that is closely approximate to the theoretical action, and they will serve the general purpose, if the power carried is inconsiderable.

179.—APPROXIMATE SKEW TEETH.

As the true involute skew tooth is difficult to construct, and in many cases is of small practical utility, and all other proposed forms are incorrect, it follows that we must depend for practical purposes mostly upon some approximation, provided it is not possible to avoid the skew gear altogether.

The blanks can be constructed by a definite process Construct the frustra of the pitch hypoids by the method of (172) and Fig. 155. Consider the end sections *mn* and *pq* as ends of a frustrum of a pitch cone, and on this pitch cone construct the blank gear exactly as for a common bevel gear.

Having constructed the blanks, the general direction of the tooth is to be marked upon them. Mount each blank as in Fig. 155, with its axis parallel with a plane surface *Z*. Set a surface gauge with its point at the line of the directrix *W*, and with it mark the position of the directrix on the pitch line at each end of the blank.



Substitute train.
Fig. 164.

The tooth must then be cut so that its direction follows the directrix, and it is to be noticed that it is not only askew with the axis, but that the tooth outline twists. The appearance of the tooth on either rim, as well as upon any section between the two rims, is the same as upon a common bevel gear, symmetrical, and not canted to one side, as is sometimes taught.

The approximate tooth is very similar to the twisted bevel tooth, see (155) and (99), with the twist following a straight line seaskew with the axis, and as the line of the twist is not parallel with the conical face, that face should be as short as possible.

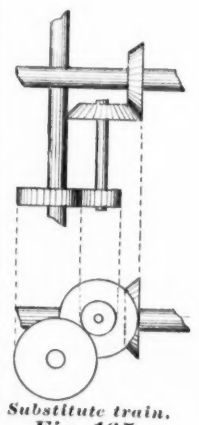
The process of cutting is not capable of description, for it depends upon personal skill and judgment. The workman must imagine that he sees the twisted cut in the body of the blank, and then must persuade the cutter to follow it. Gear cutting machines are seldom so made that the cutter can be turned while it feeds, and therefore it must be set to a medium path, and reset two or three times to get the desired form. The beginner will fail the first time, and there may be several failures. The best possible result can be bettered with a file, after running the cut gears together to find where they interfere.

In the hands of a skillful workman, a passable approximation can be reached, and if the axes are very near together compared with the diameters of the gears, the teeth are small, and the face is short, the result is satisfactory. In fact, when the conditions are favorable, this approximate tooth is more serviceable than the true tooth.

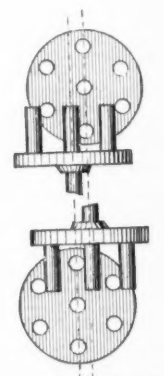
180.—SUBSTITUTES FOR THE SKEW BEVEL GEAR.

When there is a chance to introduce an intermediate shaft, the skew bevel gear can be avoided, and it is not only better, but cheaper to avoid the objectionable gear at the cost of the extra mechanism.

Fig. 164 shows how to place an intermediate shaft and gears, when the shafts are so far apart that the shortest or gorge



Substitute train.
Fig. 165.



Skew pin bevel gears.
Fig. 166.

distance can be used. Fig. 165 shows how the skew shafts can be connected by one pair of bevel gears and one pair of spur gears, and that is the best device for general purposes.

181.—SKEW PIN GEARING.

Fig. 166 shows a pair of skew pin gears commonly called face gears. They will run together with a uniform velocity ratio if they are exactly alike and at right angles with shafts at a distance apart equal to the diameter of the pins.

If the gears are not alike or not at right angles, the teeth on one may be straight pins, but those on the other must be shaped to correspond.

Such gears are objectionable because they have but a single point of contact for each pair of teeth, at which they slide on each other with great friction.

Face gearing in its various forms is thoroughly examined in MacCord's Kinematics. At the present day they are not in use, and do not deserve much study.

First Reporter—"A fire down street, did you say?"

Second Reporter—"Yes. The engines have just gone down. It's going to be a big blaze, too!"

"How do you know?"

"Because it's in a fire-proof building"—*Cape Cod Item.*

The Board of Trustees of the Brooklyn Bridge has recently voted a material increase in the salaries of the bridge employes; it isn't generosity, perhaps, but a sense of justice, that prompted the vote. These employes are hard worked, and we are glad that this hard work receives appreciation.

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NEW YORK, DECEMBER 25, 1890.

CONTENTS.

PAGE.

Sixty-inch Heavy Forge Lathe.. 1
A New Self-regulating Automatic Grain Scale.. 1, 2
Block Brakes..... 2, 3
Polishing Wheels. By F. H. Treacy..... 3
Double-arm Machine-molded Pulleys. By W. A. Jones 3
A Historic Furnace..... 3
Practice and Precept..... 3
The Measurement of Power. By J. J. Flather. 4
Apprentices—Notes on Pumps. By W. H. Booth..... 4, 5
Reform in Boring Tools. By A Mechanic..... 5
As Fine as Silk. 5
Letters from Practical Men: How He Bored the Cylinder Head. By Benj. F. Wilson—Improving a Wire Gauge. By O. C. Woolson—Critical Notes—Engine Wreck—Unlimited Job Work. By Bell Crank—Points About Grinding Operations. By C. W. Crawford.... 6
Sketches of an Apprenticeship. By W. S. Rogers..... 6, 7
Odontics, or the Theory and Practice of the Teeth of Gears. By Geo. B. Grant..... 7
Making Tin Plate in America..... 8
Questions and Answers..... 9
Manufactures..... 9, 10
The Iron and Steel Institute in America..... 10, 11
Discharge of Steam through an Orifice..... 11
A New Lathe Tool..... 11
A Convict's Patent..... 11
They Don't All Say So..... 11
Machinists' Supplies and Iron..... 12

Making Tin Plate in America.

In our issue of November 6, 1890, we expressed the opinion that, as a result of the recent legislation to this end, American energy and mechanical skill would soon find a way to establish this great branch of manufacture firmly upon American soil, notwithstanding the absurd utterances of those injudicious persons who thought the problem a mere puzzle which could be solved in a fortnight or so, on the one hand, and of those persons on the other hand who were confident nothing could possibly come of the movement, because American made tin plate was not yet on the market.

We have received from Messrs. Norton Bros., of Chicago, some sample sheets of tin plates which are of excellent quality, and which we are informed are from the "first run" that firm has just turned out from its newly erected tinning plant located at Maywood, Ill. The firm is among the largest users of tin plates in this country, and they are hard at work in carrying out their plans to manufacture the plates commercially and on a large scale for their own use and for the general market as soon as the necessary plant can be erected and put into operation. They have not yet got to the point of themselves rolling the sheet steel required for the purpose, but the necessary plant for that work also is now under construction.

It will not be forgotten that the eminent Welsh and English engineers who recently visited this country were of opinion that the new rate would not prohibit importations and that the additional protection of about one cent net per pound, which is to take effect July 1, 1891, was not sufficient to induce them to remove their tin plate works to this country, or to start new works here. But Messrs. Norton Bros., from their experience so far, express entire confidence that American ingenuity and push will, within a reasonable time, make it answer the purpose of establishing the desired branch of manufacture in America on a scale large enough to meet every requirement.

As an earnest of the kind of work the undertaking will demand on their part, and of the manufacturers elsewhere who are making like efforts, Mr. Edwin Norton, of this firm, has already devised mechanism for cleaning the plates, which is an important part of the tinning process, and which does work that in England is performed by the cheaper paid hand labor of a troop of women. By this and other similar economies, the firm expect, under the new conditions, to compete successfully with the British makers, while paying very much better wages to their workmen.

Their further progress will be watched with the greatest interest. Mechanics, at least, know that the successful establishment here of the new industry will involve the building and operating of a vast amount of new machinery, while quickening business in many related industries.

The importance of making this country industrially independent of Great Britain, with respect to a product in such universal use, if it is reasonably practicable, is shown by the fact that the United States consume, as we understand, about three-fourths of the entire tin plate product of the world, and yet, until now, we have not been manufacturing a single pound of tin plate in this country, or making any substantial movement towards that end. Certainly it involves no necessary argument as to the principles which should underlie the general economic system of the country, to say, that system being what it is, that the friends of the American tin plate industry are entitled to the full weight of their argument in favor of the maintenance of equal conditions in that industry, with those prevailing in other industries, under that system.

Among the important advantages which users will derive from getting a home base of supplies for this material, instead of one located in a foreign country 3,000 to 4,000 miles away, are the greater facilities afforded for the procuring of special sizes of sheets promptly for special work without being required to pay practically as much for a small as a large size.

Another advantage consists in the fact that in the home-made product it will be practicable to have the sheets cut to finished size, ready to be subdivided before tinning, thus putting the waste steel back into the furnace to melt over, while the tin that would otherwise be used upon this waste remains in the pot for use in tinning whole sheets. In many cases, too, where the tin plates are to be used on the premises, the expense of boxes will be saved to the user. The American buyer, also, will profit by the greater facilities which closer relations with the manufacturer will naturally afford him for getting the uniform quality and gauge throughout a large order that he now pays for, and frequently does not get.

Of course there are many who believe the American people should not consent to make any sacrifices—if any are needed—even for the purpose of transferring the manufacturing headquarters of a great industry of this kind to the United States. Possibly the voices of many such individuals are raised, not less freely than those of other citizens, in support of the policy of spending millions upon the building of armed cruisers, which are chiefly useful for the defense of our country in war. Such persons, as matters have heretofore stood with reference to the indispensable product under discussion, would do well to consider the additional millions our people would be called upon to spend, for tin plates alone, in the improbable, let us hope—but yet not impossible—contingency of a war which would cut off our source of supply!

Many of the towns in the Central States to which natural gas has been piped from distant fields are being partly deprived of its expected benefits by what appears to be either a sudden failure of the supply or mistakes as to the size of pipe required to supply a town when carrying the gas thirty to fifty miles.

Early in the fall the shops and factories in Richmond, Ind., which had been using natural gas, were notified that they must prepare to burn other fuel during the winter, as the pipe supplying the town would not carry enough gas to supply both them and domestic consumers. Now Springfield, Ohio, a manufacturing town to which the gas is also piped from a distance of fifty miles, is in the same predicament. Manufacturers who have gone to considerable expense to fit up for burning the gas having now to incur the expense of changing back to coal. Columbus is supplied from wells about fifteen miles distant, and in these the pressure of gas has declined so that the supply for domestic uses is not complete. At Lancaster and Toledo the same condition of affairs is said to exist, and it seems probable that the predictions of Prof. Orton are to be sooner proven true than even he apparently expected. In this connection it may be interesting to note that Prof. Bickmore, in a recent lecture delivered in this city, expressed the opinion that both gas and petroleum would probably be exhausted within a few years. It is reported, however, that a high-pressure well has been recently opened at Pittsburgh, where the gas has been most used, and it may be that the supply will not be wholly exhausted until the earth's crust is pretty generally perforated by wells. It will probably be a sad day for some of the "gas towns" when their supply is finally cut off, for some of them seem to possess little else to recommend them to manufacturers or to any one else.

A machinist distinguished himself in New York harbor a few days ago. His name is Maseira, and he is in the engineer's department of the Brazilian navy. Several ships of the Brazilian navy have been visiting this port, and while here the men suffered intensely from cold, their ships having evidently been constructed with the idea that they would probably never be navigated outside of the equatorial regions. The men were so benumbed by the Borean blasts of our North River that they did not exhibit sufficient spryness in obeying orders to suit the officers, and it was said to be a common thing to see them belabored with rawhides. But the machinist Maseira, who had been ordered to run the steam cutter for the day, took a cutlass and laid a seaman's head open with it, because, not moving quite fast enough, he muttered something about the cold when urged to move faster. When the fleet sailed away it was doubtful if the seaman could recover from his wounds, which were very serious. It is to be hoped that justice in some form will overtake Maseira in some way.

On another page of this issue will be found the conclusion of Mr. Geo. B. Grant's articles on the Teeth of Gear Wheels.

For the practical men—those who work in shops and have gears to construct—we consider this series of articles especially valuable, and we know there are many mechanics whose sentiments we express when we say that Mr. Grant is entitled to the thanks of the craft for the manner in which he has, in his treatment of the subject, made plain that which is essential to know and left out that which is non-essential and only tends to confusion. There are some points upon which other mechanics would differ from the author, and indeed it seems probable that there are many points connected with the subject of gear teeth that will, perhaps, never be definitely and authoritatively settled; but it is safe to say that the shop man who has gears to make for any purpose, and does not feel quite sure that he knows how best to proceed in the making of them, will be pretty sure to find help somewhere in these articles.

They are being extensively reprinted from our columns in English journals, and evidences of appreciation are not lacking here.

We continue to see frequent references in the newspapers to the Mount Carmel Aeronautic Navigation Co., of Chicago, with its alleged $20,000,000 of paid-up capital and its air ship of aluminum which is to revolutionize the carrying trade of the world. We have never classed aerial navigation as among the certainly unattainable things, and the $20,000,000 feature is about the most improbable one, it seems to us, connected with the scheme. But we wish to call attention to the fact that when successful air ships are constructed other things besides the carrying trade will be revolutionized. Attention has been before called to the fact that air ships will make every foot of land in every country a port of entry; and that means a very great deal, as will be seen by a little study of the matter.

But for the splendid condition of the manufacturing interests, there is little reason to doubt that during the past two months this country would have passed through a good-sized financial panic. Most of the elements necessary for such an upheaval have been at hand. The money market has been feverish, confidence in Wall street has been lacking, and big speculators have been getting in their work. Against all these disturbing features the great manufacturing interests of the country have stood like a solid wall. It is only those interests that depend upon an ever-fluctuating Wall street basis that have suffered seriously in the recent attempt at a panic. The solid manufacturing institutions of the country standing firmly on their own foundations—uninfluenced by speculative features—have saved the country from a misfortune. Wages have been paid and expended, and the little ripple that a few men can make has hardly been felt.

There is no doubt that the failures of several large companies engaged in the building trade in this city are directly traceable to labor troubles—boycotts and the like. It is not to the interest of any parties that such failures should result. And the exercise of a little common sense ought to prevent it. In the first place it is idle for capital to assume that labor organizations can be broken down. They have come to stay, and in the main will, in accordance with human nature, grow stronger from opposition. On the other hand, capital will protect itself by its inherent weight, and, if need be, by organization. Let each recognize the strength and the rights of the other, and strife will cease.

Employes of the Central Railroad of New Jersey who are at present living on the line of the road at some distance from its termination across the North River have received a circular from the division superintendent, which, after calling attention to the inconvenience and delay resulting from this, says:

"You will make your arrangements to live at Bergen Point, Centreville or other convenient locality near your work, so that you can promptly respond when called upon for service. This will avoid the continued and unnecessary deadheading of a large number of employes over the road in both directions. Please advise me how soon you can make the change."

There seems to be two sides to the matter. On the one hand it is undoubtedly much better and more convenient for the trainmen to live near the end of the division, and their living at a considerable distance from it is without doubt the cause of much trouble, inconvenience and delay in making up train crews for freight service.

On the other hand, it looks hard that men should be so imperatively ordered to break up their homes in the places where they pre sumably prefer to live, and move to other places where they do not wish to live, and which on many accounts are less desirable as places of residence. It at least seems that the matter might have been presented to the men in a more considerate manner—a little more as though they were looked upon as reasonable and sentient beings. The unnecessarily arbitrary and unpleasant ways of doing necessary things are responsible for more of the trouble between employes and employers than almost any other single cause.

Watson & Stillman, of this city, call our attention to a mistake which occurred regarding the water pressure to be used with their hydraulic bending machine, which we illustrated and described last week. Instead of 300 pounds pressure it should have read 1,500 pounds.

Personal.

We are informed that Joshua Rose, who has for some time past been residing in England, is now on his way to this country for a visit. He will make his headquarters while in this country at 550 Hudson street, New York.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(482) M. E. S., St. John, Mich., writes: Please give me the horse-power of an engine with cylinder 2¼ inches diameter, 3 inches stroke, number of revolutions 300 per minute, boiler pressure 100 pounds. *A.*—About 1 horse-power.

(483) H. H., West Troy, N. Y., writes: Please give a solution of the following problem. A brake acting on a drum is fulcrumed at one of the sides of the latter, the brake rests on the drum, the lever is extended at the other side, and its outer end is weighted. The distance from the center of the drum to the fulcrum, and the distance from the center of drum to the outer end of lever, also the brake pressure, is given. It is required to find the weight at the end of the lever. It seems to me that if we designate the distance from the fulcrum to the center of drum by b; the distance from the fulcrum to the center of weight by a; the weight by P; and the brake pressure by R, then $bxR=axP$, will help to solve the problem. *A.*—You are right as far as you have gone, but you have not extended your investigation far enough. See article treating on this subject in this issue.

(484) J. H. T., Albany, N. Y., writes: I want to study up the best works published relating to laying out and making the patterns for all kinds of architectural work executed in stone. I have a chance to get a first-class position this coming spring where only the best building stone work is done, and I want your advice as to the best practical works for me to study. I have studied arithmetic and know something of algebra and plain geometry, and have had some experience in making patterns for ordinary stone work. It would be of great benefit to me to master the whole subject this winter, and I would be very thankful for your guidance. *A.*—Work of this class is based upon the principles of descriptive geometry, and if you wish to become thoroughly competent to lay out any kind of stone work with confidence and without having to refer to any books for guidance, you should become familiar and understand all the principles in descriptive geometry. Davies' Descriptive Geometry is considered to be one of the best. But this work does not treat on any practical problems, and since your time is comparatively short to apply these principles to practical problems, we should advise you to employ a teacher who can give you a good start, and then continue your study during leisure hours. We have not had sufficient experience in laying out stone work, and, therefore, we cannot recommend any practical works on this subject. But we do know that the study of descriptive geometry is of the utmost importance.

(485) G. H. B., Auburn, Ala., writes: Some five or six weeks ago I wrote to you asking three questions on mechanical subjects. The answers have not been published. May I ask why? I thought the Question and Answer column was open to all subscribers *A.*—As you do not repeat your questions, we are unable to identify them, and cannot tell certainly whether we have received them or not. But even where questions are promptly received it is usually the case that the answer is as much as three or four weeks in appearing, and often much longer than that; sometimes because there is considerable work involved in the answers and sometimes because there are more questions to be answered than we can find room for in the columns devoted to that purpose. Your supposition is correct, the column is open not only to all subscribers, but to everybody else as well, whether subscribers or not; but each must take his turn and wait patiently until his questions can be answered 2. Will you please tell me also through the same channel the best manner of hardening lathe centers? *A.*—Any method is good which heats the points only without heating that part which goes into the spindle. It is important that this part should not be heated, for the reason that it seldom fits well after being heated and is an abuse of the center holes, which are bored and reamed with great care. The best method of which we are aware is to heat by a lead bath. If the shop is not provided with one regularly it can be improvised with a ladle or crucible and a blacksmith's forge.

(486) D. R. A., Germantown, Pa., writes: Please give me a simple and reliable rule for determining the amount of water required to condense the steam from a simple or compound engine, initial pressure, point of cut-off, diameters, length of stroke and piston speed being given. Would like to have this to compute the required capacity of an independent condenser. *A.*—Multiply the temperature of the exhaust steam by 0.3; add this product to 1,114°, and from this sum subtract the temperature after condensation, or that of the hot well, and call the result the remainder A. From the temperature, after condensation, subtract the temperature of the cooling water, giving a difference B. Divide the remainder A by the difference B; the quotient will be the required quantity of cooling water in pounds. This rule, given by symbols, is as follows: Let T_1 be the temperature of the exhaust steam; T_0 the temperature of the cooling water; Q the quantity in pounds of this cooling water; and T_2 the temperature after condensation, or that of the hot well. We then have,

$$Q = \frac{1{,}114^\circ + 0.3 \times T_1 - T_2}{T_2 - T_0}.$$

To illustrate, let it be required to find the amount of cooling water for an engine which exhausts its steam at 10 pounds pressure absolute; the temperature of the cooling water is 60 degrees, and the hot well is to be kept at 120 degrees. The temperature of the exhaust steam at a pressure of 10 pounds absolute is 193 degrees; this is readily found by referring to steam tables given in many books treating on engineering. Now, substituting for the symbols their values, we have

$$Q = \frac{1{,}114^\circ + 0.3 \times 193 - 120}{120 - 60} = 17.53 \text{ lbs.}$$

This answer means that the amount of cooling water is equal to 17.53 times the weight of steam in this particular example. The temperatures are all in Fahr. degrees. 2. Can you recommend a book or books treating on the expansion and condensation of steam, and on indicator practice? *A.*—Manual of Marine Engineering, by A. E. Seaton, and Indicator Practice, by F. F. Hemenway, are good books.

(487) G. K., Louisville, Ky., writes: Please give your opinion of a return tubular boiler 7 feet diameter, 18 feet long, externally fired. It has one hundred and thirty-four 4-inch tubes, steam space 21 inches, water space 63 inches of its diameter. The total heating surface is about 2,855 square feet; the material used is the best boiler steel, $\frac{7}{16}$ inch thick for shell, and ¾ inch thick for the heads. Seams are double-riveted, diameter of rivets ¾ inch; all holes are bored. What would you consider its horse-power to be? What should be its grate surface? And what should be its working pressure? Is its diameter and length well proportioned for a battery of boilers to furnish steam from 3 to 4,000 horse power for stationary purposes? If a steam drum is used for a pair of such boilers what would you consider its proper length and diameter? *A.*—The horse-power of a boiler is often estimated by allowing 15 square feet of heating surface per horse power, and according to this estimate your boiler will be about 190 horse power. But such an estimate is not satisfactory for determining the number of boilers in a plant as expensive as yours, because if these boilers have to furnish steam for poorly constructed engines a greater number of boilers will be required than when steam is to be furnished to first-class engines. The proper way is to determine the amount of steam required to run the engines, and use that as a basis for computing the horse-power of the boiler. The grate surface should be about 80 square feet to each boiler. It will be a difficult matter to keep an even fire on so large a grate surface, and this is one objection to boilers as large in diameter as yours. Another objection is that, when it is necessary to make repairs to a boiler, the reduction of the available working pressure of the remaining boilers will be felt too much, hence, it is better practice to use boilers of smaller diameter for a length of 18 feet, so that when one of the boilers has to stand idle the others can still furnish the required power. The working pressure should not exceed 85 pounds. The drum, connecting two boilers, we should make about 40 inches diameter and about 12 feet long. 2. An upright boiler with one hundred and forty 3-inch tubes 20 feet long, and a furnace 41 inches high and about 5 3 inches diameter is rated at 175 horse-power. Please explain how they get heating surface enough for that number of horse-power. *A.*—In estimating the horse-power of this boiler, about 12 feet of heating surface per horse-power has been allowed. Some boiler makers adopt this measure.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Friday morning for the ensuing week's issue.

Grant's (1891) gear catalogue ready. See adv. p. 20.

Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
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Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

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The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

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Special Tools for Railway Repair Shops. Pedrick & Ayer, Philadelphia, Pa.

Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.

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Get particulars of our new Wall, Suspended and Radial Drills. C. H. Baush & Sons, Holyoke, Mass.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Dec. 18, p. 18. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Send $1 for Catalogue D, Fine Tools and Supplies. Over 550 pages. Fully illust'd. Free when $10 worth goods are ordered. Frasse & Co., 92 Park Row, N.Y.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

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S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal st., Chicago, Western Agent.

Most sensitive and durable Damper Regulator made; works within one pound; send for circular. T. Kieley, 11 W. 13th st., New York.

Billings & Spencer Co.'s Packer & Boiler Ratchet, & all kinds of Forged Wrenches. S. A. Smith, 23 S. Canal st., Chicago, Western representative.

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Patent Soliciting of High Class.
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Send for Brief History of Patent Legislation.

Wanted—One or two gentlemen to purchase president's $70,000 interest in incorporated Mfg. Co.; seller will loan company $100,000 to increase business if desired. A. L. B., Carrier 22, Buffalo, N.Y.

Agents wanted in every town and village in the United States to sell our clipper knife and scissor grinder, something that every housekeeper should have; liberal terms. For particulars address Montgomery & Co., 105 Fulton street, New York City.

Every draftsman needs one. The Engineer's Sketch Book of mechanical movements, appliances, devices, contrivances, etc., by T. W. Barber. 1,936 illustrations, 8vo. cloth, $3. Catalogue of books on mech. subjects free. E. & F. N. Spon, 12 Cortlandt st., New York.

De Lamater Screw Propeller Wheel made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Stub Ends and Connecting
Rods for small connections.
Especially adapted for Valve
Rod for Steam Engines.
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Philadelphia, Pa.

Hand-books for engineers, firemen and machinists. Hawkins' Calculations, a work of instruction and reference, $2.50; Roper's Handy Book, $3.50; Haswell's, $4.00; Reed's Hand-book for marine engineers, $4.50, postpaid. Discount of $1.00 where two are ordered. Theo. Audel & Co., publishers, 91 Liberty street, N. Y. Catalogue.

Just Ready—New Catechism of the Locomotive. The most complete treatise on the construction and operation of the locomotive, by M. N. Forney, M. E. 688 large pages, with 488 engravings, 6 large folding plates, and 20 full-page plates of various styles of locomotives. Sent by mail, free of postage, $3.50. Frederick Keppy, Scientific Book Publisher, Bridgeport, Conn.

"Binders" for the American Machinist. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton st., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 53 East 10th st., New York.

MANUFACTURES.

Moffatt Mfg. Co., Chester, S. C., is erecting a $6,000 iron foundry.

The Emerson Machine Co., of Granby, Conn., are to double their capacity.

Hughes & Patterson will erect a rolling-mill, 140x120 feet, at Philadelphia, Pa.

E. A. Ebert and others will establish a $175,000 cotton factory at Winston, N. C.

It is reported that big iron works will be located at Christy, Pa., near McKeesport.

Lill & Hillsley, of Philadelphia, Penn., will erect a nail factory in Kensington, Ga.

A contract has been given out at Bell City, Ala., for the erection of an iron furnace.

The Peninsular Car Works of Detroit, Mich., will probably be removed to Seattle, Wash.

Car wheel works are being erected at Jefferson, Tex., by the Lone Star Iron Company.

The Franklin Edge Tool Co. intend to build a hardware factory at Wilmington, Del.

A wire fence factory has been established at Bedford City, Va., by Colgate & Campbell.

The Newnan (Ga.) Cotton-mill contemplates putting in $10,000 worth of new machinery.

The Smead Foundry Company has been incorporated, at Toledo, Ohio; capital, $80,000.

A tannery, steel works and stove foundry are reported as to be established at Graham, Va.

A large foundry will be built in Atlanta, Ga., by the Westerland Electric Conduit Company.

New buildings are to be erected for the Cox & Morrison Boiler Works, at Wheeling, W. Va.

The organization of a stock company, to erect a cotton factory, is projected at Summit, Miss.

The Shenandoah Valley Railroad Company will build car shops in Shenandoah, it is reported.

A hardware factory will be erected at Wilmington, Del., by the Franklin Edge Tool Company.

Major Orrell is corresponding relative to the erection of a cotton factory in Fayetteville, N. C.

The New York Central Iron Works Co. has been formed at Geneva, N. Y., with a capital of $100,000.

It is reported that a stock company is being organized, to erect another cotton-mill, at Florence, Ala.

The Rigby Safety Car Wheel Company is a new organization at Detroit, with a capital stock of $500,000.

The Hampton Corundum Wheel Company, of Chester, is to remove to Brightwood, near Springfield, Mass.

The Virginia Iron Company will expend, it is stated, $100,000 in improving its iron furnace at Goshen, Va.

The Chattanooga (Tenn.) Machinery Company is reported as to put additional machinery in its machine shop.

The Knoxville (Tenn.) Southern Railroad Co. is reported as having secured site, and is to erect machine shops.

The Canton Malleable Iron and Manufacturing Company is a new concern at Canton, Ohio; capital, $100,000.

The Marietta Electric Company, Marietta, Ga., will, it is reported, put new machinery in its electric light plant.

The Ruton Manufacturing Company has been incorporated, at San Angelo, Tex., with a capital stock of $30,000.

A large machine shop connected with the Duluth, South Shore & Atlantic R. R. is to start up soon at Marquette, Mich.

A Chicago (Ills.) party is reported as having made a proposition to build a Bessemer steel plant at Fort Worth, Tex.

An iron pipe works plant will be established at Ivanhoe, Va., by a Philadelphia company, now reported organizing.

The Cahill Iron Works, Chattanooga, Tenn., is reported as enlarging and increasing the capacity of its iron foundry.

The St Joseph Bridge and Boiler Works have been incorporated, at St. Joseph, Mo., with a capital stock of $42,000.

The proposed Corpus Christi & South American Railway will, it is reported, erect machine shops in Corpus Christi, Tex.

Hazleton, Pa., is to have a nail factory with $120,000 capital stock. It is to be established on the co-operative principle.

A report is current that the East Tennessee, Virginia & Georgia Railroad Co. will erect machine shops in Rome, Ga.

J. F. Johnson, in company with Eastern capitalists, is thinking of establishing a 75-ton rolling-mill at Birmingham, Ala.

The Halifax Shovel Company, Halifax, are putting in a lot of new machinery to enable them to increase their output.

It is stated that negotiations are in progress at Florence, Ala., for the erection of a furnace, a tube plant and a rolling-mill.

The Rolistone Machine Co., at Anniston, Ala., contemplate increasing their capital stock, and building an iron foundry.

Messrs. George Waring and Oscar White are erecting and will operate an iron foundry and nail factory at St. John, N. B.

J. F. Johnston, of Birmingham, Ala., is negotiating with a party for the construction of a $125,000 rolling-mill in Jasper, Ala.

The $25,000 necessary to secure the location of a brass factory at Middleville, Mich., has been paid, and the works will be built.

The Enterprise Machine Works has put in additional machinery, and will add an iron foundry to its plant at Knoxville, Tenn.

The Jenckes Machine Company, Sherbrooke, Que., are manufacturing $50,000 worth of mining machinery for parties at Sudbury, Ont.

At Chattanooga, Tenn., the Chattanooga Machinery Co. are reported as about to put additional machinery in their machine shop.

The Radford Pipe and Iron Co. is a new incorporation at Radford, Va., with a capital of $300,000, to build an iron foundry and machine works.

The organization of a $25,000 stock company to establish works for the manufacture of car axles, shafting, etc., at Dallas, Tex., is discussed.

A great cotton manufacturing company has been organized in Huntsville, Ala. It will build two large factories. The first mill will cost $500,000.

Northern capitalists are reported as purchasing $10,000 worth of land in and around Mascot, Tenn., to build a new town and construct a steel plant.

The Graham Land and Improvement Company, of Graham, Va., are reported to be negotiating for the establishment of a steel plant and stove works.

The St. Lawrence Bridge Company, Montreal, has been incorporated, with a capital stock of $25,000, to manufacture iron bridges, iron beams, etc.

Preparations are progressing at the Granite Iron Rolling-mills of the St. Louis, Mo., Stamping Company for an enlargement of the tin plate department.

At Florence, Ala., the Florence Land, Mining and Manufacturing Co. are negotiating for the construction of an iron furnace, rolling mill and pipe works.

The Kingsley Foundry and Manufacturing Company, of Elyria, Ohio, have secured a location in Hammond, Ind., and will erect on it a plant to cost $30,000.

The Monroe Iron Works, Monroe, N. C., a comparatively recent enterprise, finds itself called upon to enlarge its capacity by the addition of more machinery.

The St. Lawrence Iron Bridge Company, Montreal, has been incorporated, with a capital stock of $25,000, to manufacture iron bridges, iron beams, etc.

The Southern Machinery Company has been organized, at Atlanta, Ga., for the purpose of doing a general business in railway equipment, machinery and supplies.

The Adams Saw-mill Works, Chattanooga, Tenn., are reported as having erected a saw-mill and iron foundry, and as to erect a planing-mill, machine and boiler shop.

The committee appointed by the Mercantile and Manufacturing Bureau, Denver, Col., have raised the requisite $500,000, and the projected steel plant seems to be assured.

The Basic City (Va.) Development Company has purchased, it is stated a tract of land adjoining the city for $68,000, and that iron-working plants will be erected upon same.

It is expected that the proposed car shops of the Norfolk & Western, at Lambert's Point, Va., will give employment to 500 men. The estimated cost of the plant is $200,000.

The Llano Improvement and Furnace Company has, it is reported, contracted with an Ohio party for the erection of a $100,000 machine shop and stove foundry in Llano, Tex.

A Pennsylvania company is corresponding with a view of locating an iron foundry and nail mill in Pineville, Ky.; also, a northern company contemplates locating a pipe works there.

The Pacific Short Line will build railway shops, to cost $40,000, at South Sioux City, Ia., a proposition to vote $34,000 in bonds in aid of the project having been carried by the citizens.

Preparations are being made at Milwaukee for the erection of a car-building plant. The projectors announce that it will be a large establishment, capable of employing 1,000 men.

The Columbia Steel Car Company expects to begin building at once on the land secured in the township of Maine. The buildings are expected to be under cover by the first of February, 1891.

The Elmira Steam Generator Company were recently organized and incorporated at Elmira, N. Y., with a capital of $60,000, to manufacture steam generators and other appliances of a similar nature.

The Fitchburg Engine Company, Fitchburg, Mass., will move its entire plant to Gardner, next year, at as early a date as a building can be erected. When finished the building will be 170x70 feet.

F. E. Colboth, G E Kemper, T. J. George, and others, have incorporated the Hattiesburg (Miss.) Machinery and Car Manufacturing Co. This company has, it is stated, secured site, and will erect car shops.

The E. W. Bliss Company, Limited, is a consolidation of E. W. Bliss Company, of Brooklyn, N. Y., and the Stiles & Parker Press Company, of Middletown, Conn. The consolidation is, we believe, purely for business purposes.

A button manufacturing plant is soon to be started up at Birmingham, Ala. The projectors say they have a machine that will do the work of four of the old style and with less labor. They expect to control the market in the United States.

The stockholders of the Bethlehem (Pa.) Iron Co. voted to increase its capital stock from $3 000,000 to $5,000,000. The increase is for the construction of the new ordnance buildings where government armor plate and gun forgings are now being made.

A stock company, known as the Salem Iron Works, with a minimum capital stock of $50,000, and a maximum capital of $300,000, is reported as organized, at Salem, Va., to erect a wire nail factory, 200x70 feet. J. T. Crabtree can give information.

The Standard Elevator Company, of Chicago, Ill., has been incorporated, with a capital of $300,000, for the manufacture of elevators, general machinery, and architectural iron work. Incorporators are: J S. Root, A. Christoferson, and Thomas Parker, Jr.

The new quarters of the Cushing Wire Nail Factory, at Palmer, Mass., are occupied by that concern, and additional machinery is to be placed at once. When fairly under way, the Palmer wire-mill will supply the material from which the nails will be made.

The St. Louis Car Track Cleaner Company, of East St. Louis, has been incorporated, with a capital stock of $150,000. The company proposes to own and control devices for cleaning car track; incorporators, J. E. Chambers, Harry Goodwin and F. C. Wolpert.

The Owen Automatic Signal Company, Lynchburg, Va., has been incorporated, with C. C. Dunn, Jr., president, and W. H. Wren, vice-president, to manufacture the R. O. Owen patent railway signal, etc. The capital stock is not to be less than $100,000 nor more than $1 000,000.

A company is organizing at Ridgeville, Tenn., to establish car works, and will absorb the planing-mill of W. B Farrer & Co. Among those interested are A. S. Glover and J. F. Tipton, of Dalton, Ga. The plant will include a blacksmith forge, machine shop and car wheel foundry.

There is water-works agitation in Galveston, Tex.; Warren, Ill.; Portland, Me.; Edwardsville, Ill.; Concord, N. H; Cleveland, O.; Wall Lake, Iowa; Madison, Dak.; Amherstburg, Ont.; Grand Rapids, Mich.; Sheldon, Iowa; New Castle, Pa; Milledgeville, Ga.; Oklahoma City, I. T.

A company is being organized at Winnipeg, Man., with a capital stock of $50,000, to manufacture a steam plow invented by Mr. C. P. Brown, of that place. The incorporators include Hon. J. C. Schultz and Mr. C. P. Brown, of Winnipeg, and Hon. W. E. Sandford, of Hamilton, Ont.

East St. Louis has another new industry—the Cherry Valley Mining and Smelting Company. Its aim is to develop mines and property, and to build and operate mills and reduction works. The capital is $1,500 000. Alvis Thomas, Charles D. Hoffman and John B. Whitehead are the incorporators.

The Chicago Machine-carving and Manufacturing Company, at Chicago, Ill., has been incorporated, with a capital of $50,000, for the manufacture of interior decorations, furniture, fancy cabinet ware, moldings, and other articles from wood. Incorporators are: Edgar S. Boynton, E. W. Alleigh, and D. A. Holmes.

The Rock Hill Machine Company has been incorporated at Rock Hill, S. C., by William S. Creighton, Louis Sherfersee, John R. London and W. S. Kay, all of Rock Hill. The purpose of the corporation is to manufacture articles in wood and metals, take engineering contracts, and furnish general mechanical supplies.

The Ansonia (Conn) Brass and Copper Company continues the enlargement of its mills. The latest to receive attention is the brass-mill. To this an addition 90x155 feet is built, similar to that begun some weeks ago at the wire-mill. No new departments are to be added, but old ones are to be rearranged so that the output of the mill will be increased.

The buildings of the Norristown Steel Company, a new concern at Pittsburgh Pa., are rapidly nearing completion. The plant is so located as to be added to conveniently in case enlargement be comes necessary. Steel castings of all descriptions will be the products. The chartered capital of the company is $200,000, all stock being fully paid and non assessable.

The Virginia Car Works Company has been incorporated, at Buena Vista, Va., with a capital stock of $1,000,000, to erect and operate car works in that place. Colonel A S. Buford, formerly president of the Richmond & Danville Railroad Company, is president of the company, with F. H. Foster, of Glasgow, Va., as vice-president, and Charles Conway, secretary.

On December 8 the Secretary of State of Illinois issued licenses to the Consolidated Brake Adjuster Company, of Chicago. Its capital stock is $500,000, and its object is to manufacture devices for adjusting the slack caused by the wear of brake-shoes, and to make other useful devices. The incorporators are: Charles F. Quincy, Arthur Crandall, Richard W. Wright.

The Niles Tool Works, Hamilton, Ohio, have the contract for the complete equipment of the Lake Erie Engineering Works, at Buffalo, N. Y. The order calls for a large number of tools, heavy and light, specially selected for the work to be done. The Morgan Engineering Works, Alliance, Ohio, will furnish the traveling cranes. It is intended to make these works the most complete for the purpose of any in the country.

The Arcade File Works, now located at Sing Sing, N. Y., propose enlarging the works to double their present capacity. Their business is steadily growing, and at Sing Sing there is a lack of space to extend the works, so the question under consideration is as to whether it would not be advisable to move the entire plant to a place where increased facilities for manufacturing can be had. The concern at present employ about 150 men.

Articles of incorporation have been filed at Minneapolis, Minn., for what is to be known as the Inventors' Manufacturing Co. The nature of the business will be the manufacturing, introducing and selling of any patented machine. The corporation is to begin December 1, with a capital stock of $100,000. Joseph L. Willford, Frederick D. Blackmarr, Albert N. Ellis, Robert S. Williams, James L. Sprague and George H. Perkins are the incorporators.

Glover Bros., iron founders, at Frankford, Pa., have broken ground for a new plant, which will give employment to about 100 hands. They are to erect at once a brick building 52x120 feet, which will be divided into four large rooms with a clearance of 16 feet from floor to beam. There will be a tumbling room, a finishing shop, a machine shop 30 feet square, and a two-story pattern lott 20x50 feet. The latest improved machinery is to be introduced, together with a 35 horse-power boiler and engine.

The Iron and Steel Institute in America.

There is no more interesting study to the foreigner who visits the United States for the first time than the methods whereby the vast system of railway communication has grown up, is administered, and has developed its business. There is nothing, moreover, of which the Americans are more proud than they are of their railway system. This fact is probably only the natural outcome of the enormous extent and the consequently exceptional necessities of the country; but it is, in any event, a remarkable fact that since the period of the civil war, which laid upon the American people a debt of over five hundred millions sterling; which demoralized, impoverished, and to some extent depopulated the South; which withdrew men from useful industries, and caused manufactures and agriculture alike to stagnate; which artificially enhanced the price of all commodities, and introduced a new economic *régime*, the American people have added 130,000 miles to their then existing railway system, and have found capital to the extent of fourteen hundred millions sterling for that purpose. Not only so, but they have adapted that system of transportation to the requirements of the country in a manner truly marvelous. They have made the railways subservient to the development of the country, and have not been content that the country should be controlled by the railways. Competitive lines have been constructed wherever there was any appearance of justification for them. The initial cost of building the lines has been kept down to as low a point as possible, so that the roads were not called upon to pay interest, as they require to do in England, on a high capital outlay; new methods of handling freight were introduced, whereby the cost of transport was economized, and successive reductions of rates came into force, until the average charges became the lowest known for railway transport throughout the civilized world. The American railway problem is, in truth, well worth study. The first matter that appears to press for inquiry in considering the comparative circumstances of the railways of the United States is that of how they should be built so cheaply. It looks startling and inexplicable on the face of it to assert the fact that the average cost of American railways has only been about one-fourth that of British lines. People naturally inquire as to the items that make up the difference, and they recollect that, in the United States, wages and materials, the two main items in the cost of a railway, are far more costly than in this country. It is probable, however, that the items of land and preliminary expenses would, in the United Kingdom, explain a large part of the difference, for whereas the governments of the several States have in many cases presented to the railway corporations in America not only the land that they actually required, but considerable tracts besides, which they have since been, or will ultimately be, in a position to sell at a handsome profit, the land required for railway purposes in the United Kingdom have been purchased by the companies at prices generally far in excess of its actual worth, and often both fancy and fabulous. Not only so, but the majority of the English lines have been laid down at a time when materials of every description were much dearer than they have been over the last ten or fifteen years, which has been the most active period in American railroad construction.

So much is a matter of common knowledge and record. It requires, however, something more than this to understand the whole case. Any visitor to the United States must have been struck with three features in the railway system that are by no means common to the United Kingdom—the first, that the gradients are easy, so that tunnels and bridges are few; the second, that there is an enormously larger proportion of single line than in our own country; and the third, that the work of construction has usually been carried out, and especially so in new and comparatively undeveloped districts, in a cheap and often flimsy and unsubstantial

manner. Instead of providing a bridge or a tunnel, as the Board of Trade would require them to do in the old country, railway companies appear to have permission to do things according to their own sweet will, which is frequently concerned only with having cheap and light work. Often in towns of considerable importance, as, for example, at Pittsburgh and Baltimore, the railway runs parallel with, and intersects the public thoroughfares, without any barriers, and the streets are blocked up for hours together with trains of loaded or empty cars, round about which the vehicular or pedestrian traffic of the streets has to dodge and gyrate, at serious peril, in order to get along. The trains are, of course, required to proceed, in such cases, at a slow pace, and the everlasting clangor of the locomotive bell keeps the otherwise unwary pedestrian on the *qui vive*, but, even so, accidents are numerous, far more so than in any European country in which a different system prevails. The American people are content to bear with this state of things for a time, realizing that it is better to have railways at any price than not to have them at all; but the period is probably not very remote when the price will be deemed too high, and when a much larger expenditure in the public safety will be forced upon the companies there, as it has already been on the companies here.

The lower initial cost of the American railways has, of course, a good deal to do with the low rates at which they carry traffic, but it has not everything to do with it, and perhaps it has much less to do with that result than other considerations to be afterwards stated; at any rate, it is the fact that whereas the total expenditure per mile of line opened was not more in 1868 than in 1877, the average freight rate for the transport of wheat between Chicago and New York declined during that period from 42½ cents to 16½ cents per bushel, and has since then fallen to about 13 cents. With this reduction of rates the lower initial cost of construction has little or nothing to do. What has to do with the cheapening of transport has been the remarkable improvements introduced in the methods of handling freight, the substitution of large for smaller cars or trucks, whereby a saving of deadweight is effected, and the use of more efficient and powerful locomotive engines, whereby the load to be hauled has been doubled, tripled, and even quadrupled. These were the phenomena that chiefly commanded the attention of the men of steel and iron on their recent visit to the United States, and these are the matters with which, in Great Britain, our railways will have to reckon on in the future.

There is, however, at the bottom of all this a fundamental difference that dominates and controls the whole situation, and that is the fact that, in the United States, railways are not a chartered monopoly, as they are in the United Kingdom. In America anybody has the power, if he has the capital, to lay down a railway anywhere. In the United Kingdom, no railway can be built without the special sanction of parliament, which is usually difficult and often impossible to obtain. Hence, in the United States there is much keener competition among the railways themselves than there is in the old country. Every railway there is compelled to quote the lowest rates possible or lose the traffic. In Great Britain a railway can ordinarily command the traffic, whether its rates be high or low, because there is no alternative open to the freighter. This enforced competition for traffic in the United States has led to a healthy and beneficial competition in economy of transport, and to the adoption, in a very large number of cases, of expedients and appliances that appear to be below the consideration of the railways at home. A railway company in America struggles for traffic as vigorously as a street Arab struggles to sell his "spechul," and the freighter, instead of being the creature of circumstances created by a railway board, is really the master of the situation.

The result of all this is a system of low rates that has excited the envy and provoked the admiration of European traders. Of such rates, many examples were quoted to the members of the Iron and Steel Institute while they made their recent trips in the United States. Railways, in point of fact, are found adapting themselves so entirely to the circumstances of traders that it appears to be in America a matter of much less importance than in the United Kingdom, whether the geographical conditions are favorable or the reverse. The manufacture of iron and steel appears to be carried on as successfully at Chicago, at a distance of 540 miles from the fuel and of 437 miles from the ores employed, as at Birmingham, Alabama, or Chattanooga, Tennessee, where the minerals are found almost together. At Bethlehem, Pa., ore is brought a distance of 361 miles, and fuel a distance of 330 miles, at an average rate of a little over a farthing per ton per mile, so that the total transport cost of assembling the materials required to produce a ton of pig iron from those distances does not exceed 4½ dols., or, say, 18s. per ton. The facilities afforded for the transport of the manufactured commodities are equally good. Rails are sent to New Orleans from Chicago, a distance of 915 miles, for four dols. per ton, or 0.43d. per ton per mile, which is probably a much lower rate than was ever heard of in the United Kingdom for a similar service. And these, it should be remembered, are gross charges, and are not, as in the United Kingdom, merely the basis for a superincumbent charge for station and service terminals, that almost, if it does not sometimes entirely, equals the mileage charge. The most marvelous thing of all, however, is that the American railways charge considerably less than a halfpenny per ton per mile for the whole of their traffic, merchandise as well as minerals. This is a much lower average transportation rate than is to be found in any other country, although Germany, with an average three-farthing rate, is working steadily down to a similarly low figure.

It is the practice of prudent railway administrations everywhere to do what they can to encourage and develop trade, but nowhere is this principle carried further, or put into more successful operation, than in the United States, and especially in the Southern, which are in some respects the newest States of the Union. The South has all the materials, and it has manifested to the fullest extent the ambition to become a great iron-producing district. But as its own consumption was limited, it was a *sine quâ non* that easy access should be afforded to a larger market than the one which lay at its door. Two things, therefore, became imperative—the first, that facilities should be afforded whereby the South could produce iron cheaply; the second, that iron so produced should be easily placed on the largest possible market. The railway companies concerned have met both conditions in a way that will redound to their own credit, and the South's great gain. The actual rates charged in the South for the transport of iron ore vary from less than a halfpenny per mile for distances under 30 miles to less than 0.3d. for distances over 100 miles, while for distances of more than 150 miles, pig-iron is carried from the South at the remarkably low rate of a farthing per ton per mile. If the South is to secure the position as a manufacturing center that has often been predicted for it, much will be due to the fostering and unselfish policy of the local railway companies.—*London Engineering.*

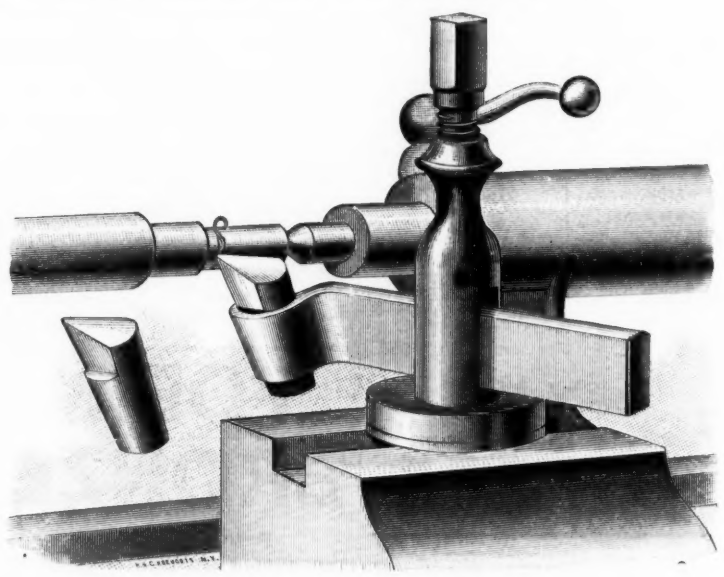
Discharge of Steam through an Orifice.

At a meeting of the Engineers' Club, of Philadelphia, on December 6, Mr. Strickland L. Kneass presented a paper on the Internal Condition of an Elastic Fluid during Discharge through an Orifice.

The theoretical conditions of discharge required to produce a maximum terminal velocity were first considered, and after showing the application of the law of adiabatic expansion, the action of the discharging jet was clearly shown by diagrams plotted from actual experiments.

These indicated the relation of the expansion and velocity to the forms of nozzles used, and showed the changes in shape requisite to produce the highest efficiency at different steam pressures.

The experiments were described in detail, and consisted of observations taken from a brass tube 0.3" diameter, pierced by seven small holes. Upon these were placed pressure gauges, and the tension of the steam was obtained at seven different points of the tube; from this data was determined, and graphically shown, the velocity of the steam at every point of expansion between initial and terminal pressures.



A NEW LATHE TOOL.

The phenomena of discharge under some conditions were peculiar; one experiment showed an actual tension of the steam from five to seven pounds below atmospheric pressure, even though the tube was discharging freely into the air.

The paper closed with a description of a nozzle proportioned upon the theory of constant acceleration. The results obtained with this tube fully confirmed the truth of the theory, as the terminal velocity of discharge approached very close to the theoretical value, and indicated a higher efficiency than any other form of nozzle.

A New Lathe Tool.

We give on this page an illustration of a lathe tool, which has interchangeable points and yet is composed of only two pieces. The end of the holder, which fastens in the tool-post in the ordinary manner, is enlarged and bent downwards, as shown, a plain taper hole being bored through it. The cutters are all made with taper shanks to fit the hole, and only need to be gently tapped into place to hold securely, and when they are to be removed a light tap on the projecting lower end loosens them, and the holder need not be removed from the tool-post. The cutter can be put in as for a straight tool or may be turned either to the right or left, and the cutters are furnished of any desired form. Being small, a great number of shapes, made of the best steel, can be afforded. A box with a sliding cover and with holes in the bottom for the reception of the taper shanks goes with each tool, and they are thus kept together and convenient. Two sizes of tools are regularly made—$\frac{3}{8}$"x$\frac{3}{4}$" and $\frac{1}{2}$"x1"—each having 10 cutters or points, and other sizes, as well as any form of cutters, are made to order by the makers, S. W. Reese & Co., 182 Fulton street, New York City.

A Convict's Patent.

Charles G. Root and Manuel Eyre have begun a suit in equity in the United States Circuit Court against Charles Sonntag, E. J. De Pue, Patrick Reddy, Robert T. Devlin, and Joseph Craig, of the Board of State Prison Directors. Root claims to have, in April, 1887, invented a certain improvement in loom shuttles, which he patented in October of that year, and he assigned a one-half interest in the patent to Manuel Eyre. They claim that the Board of State Prison Directors have used this patent in the jute-mill at the San Quentin prison, in violation of the complainants' exclusive rights to the patent, and without their consent. Root and Eyre ask that the directors be made to account for and pay over to them all the profits of the patent since it has been in use in the State prison, and that the directors further be assessed for all damages for infringement of patent. At the time Root invented the improvement on the shuttle he was a convict, serving out a sentence in San Quentin, and was employed in the jute-mill.—*The San Francisco Alta.*

They Don't All Say So.

One of the most punctilious statesmen who has ever been in Washington was Hannibal Hamlin. He did not believe that he had any right to use information which he got as a public servant to advance his private interests, and he once refused to buy a whole square in Washington for one-half a cent a foot on this ground. Had he made the purchase he would have been now a millionaire, for this square is worth about $3 a square foot to-day. He acted the same in regard to bonds, and at one time one of his fellow Senators, in speaking of a bill which was before the Senate, asked him to vote for it, telling him he could take him to a place where he could get all these bonds he wanted at 6 cents on the dollar, which would be worth 100 cents when the bill passed. He closed with: "Well, Hamlin, what do you say to the chance?" "I say," replied Hamlin, with an angry frown, as he turned his back, "I say d—n your chance and d—n your bonds." And that was the end of the matter.—*Denver Times.*

The city of New York spends enough money for the purpose of cleaning the streets to have the cleanest streets in Christendom. The manner in which this money, in spite of all protests and complaints, is spent by the politicians without coming near anything resembling clean streets, constitutes a very strong indictment against their rule.

Some of the streets of the city are now said to be so filthy as to cause danger of epidemics, and the Board of Health has made formal complaint of their condition. It is difficult to imagine a worse mismanaged thing than the streets of most any of our great cities. They are not so made as to be kept clean without enormous unnecessary expense, and they probably cannot be so made so long as they must be dug up and the pavement destroyed every time a new pipe of any kind is to be laid or a leak occurs in any of the numerous ones already laid. The only final solution of the difficulty is in the construction of subways and their compulsory use.

Until recently it has been the practice on the Erie Railroad to "lay off" men, "pending investigation" of the charges against them, and in many cases the investigation was a long time pending, and when it happened that the investigation which finally took place showed the man to be blameless, he was usually unable to perceive the justice of losing his pay during the time

of enforced idleness, imposed for an offense of which he was declared to be innocent. The injustice was strongly objected to, and finally it has been ordered that, where a man has been declared blameless on the charge against him, he shall be paid in full for the time lost. This will probably result in more care being taken about laying men off pending investigation, and the average time between the making of the charges and their full investigation will probably be much shortened.

The old-fashioned gas lamp had one redeeming feature. It revealed to strangers the name of the street upon which it was located. But with the advent of the electric light this is all changed. This may seem a small matter, but is it? Jones & Johnson, for example, may advertise their business at a certain street and number in a city. Perhaps a hundred other firms, in as many cities, are in the same business. Smith wants to buy, and he is in a hurry. He visits the city where Jones & Johnson are located, and wanders about aimlessly; nothing to indicate the streets. Probably he goes away disgusted, and leaves his order in some other city. This is not fancy. It is what occurs every day, as we happen to know.

A dispatch from Chattanooga, Tenn., says: H. I. Kimball, formerly of Atlanta, but now engaged in developing East Tennessee interests, cables that he has sold to English capitalists for 1,000,000 pounds sterling nearly 5,000,000 acres, a three-fourths interest in the property of the Kimball Town Company, located in the famous Sequatchie Valley, about fifty miles from here. This is, perhaps, the biggest real estate deal ever negotiated in Southern lands. The property is rich in minerals and timber.

The makers of crackers in New York have gone into a "trust." We hope they will succeed—in making better crackers.

Machinists' Supplies and Iron.

NEW YORK, December 20, 1890.

Iron—American Pig—The market continues to rule quiet, and consumers are buying no more than their immediate demands require. There seems little disposition among them to make contracts for next year's supplies, for the reason apparently that it is probable that there will be a little more settled condition of things after the first of the year. The iron trade, considered by itself, is in good condition, and ready to respond to any improvement which may occur in the general condition of financial affairs.

No. 1 Foundry, standard Northern brands, $17 to $18; No. 2, $16 to $16.50; Gray Forge, $15 to $15.50; Southern brands No. 1 Foundry, $16.50 to $17; No. 2, $15.75 to $16.

Scotch Pig—Sales have been very limited and quotations are nominal only.

We quote Coltness, $24.50; Dalmellington, $22 to $22.50, and Eglinton, $20.50.

Copper—The market has ruled dull and weak. Consumers evidently expect a general decline, and are holding off in the matter of contracts. Lake has been offered at 15¼c., but there were no buyers. Casting brands are nominal at 14c.; Arizona, 14¾c., but if actual sales were to be made lower figures would form the basis of them.

Lead—The market has shown no change of importance during the week, and values are still considerably unsettled. Values are at about 4c. to 4.10c.

Spelter—The market has been quiet, and there has been very little trading except to supply current needs.

We quote ordinary brands of Western at 5.90c. to 6c.; choice, 6⅛c. to 6¼c.; refined, 7¾c. to 8c.; Silesian, 7⅜c. to 7½c.

Tin—Prices in London have advanced, and there is on that account a firmer feeling here, and values have slightly advanced, the business actually transacted, however, being of very moderate proportions. Jobbers ask 21¼c. to 21¾c.

Lard Oil—Prime is sold at 49c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Exp. foreman of mach. shop, building heavy machinery, desires to change. O. H. B., AM. MACH.

Wanted—A first-class temperer. Chester Twist Drill and Tool Co., Chester, Pa.

Wanted—Situation by sober and steady pattern maker in the South or S. W. "R.," AM. MACHINIST

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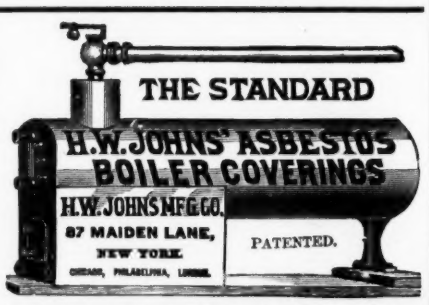

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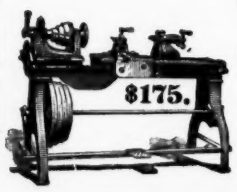

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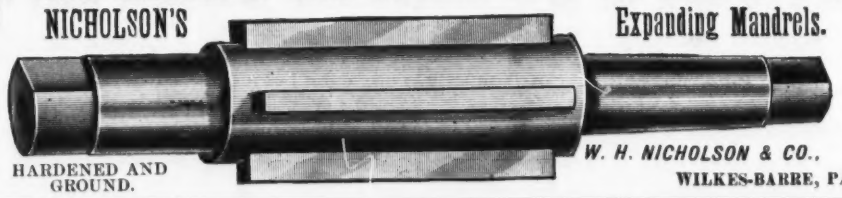

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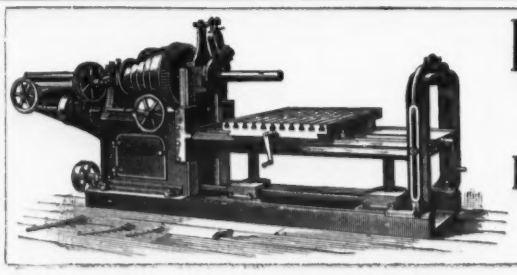

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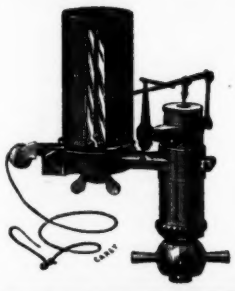

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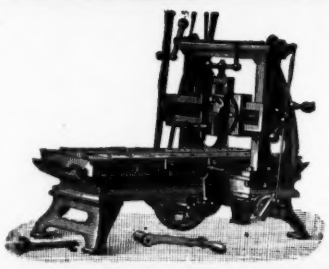

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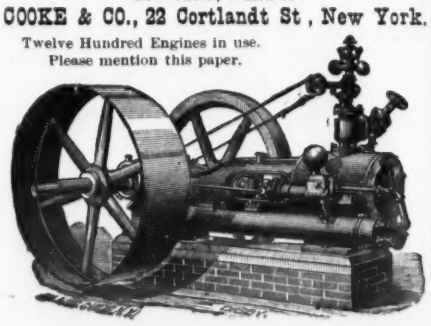

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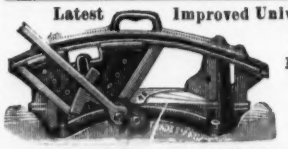

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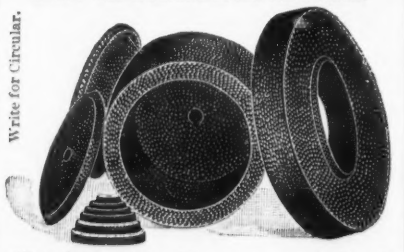

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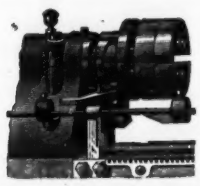

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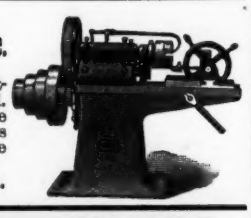

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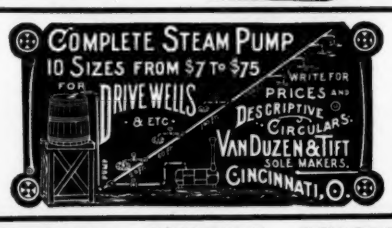
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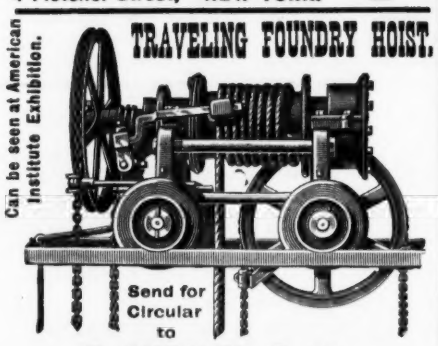

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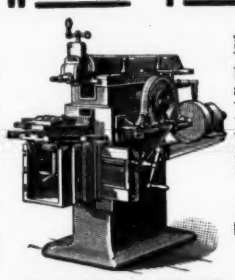

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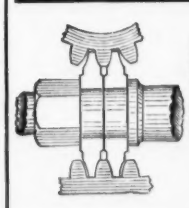

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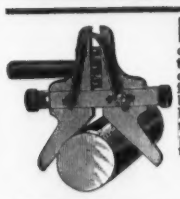

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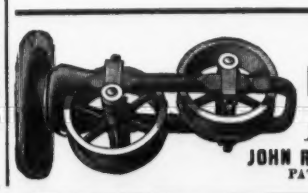

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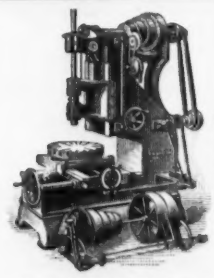

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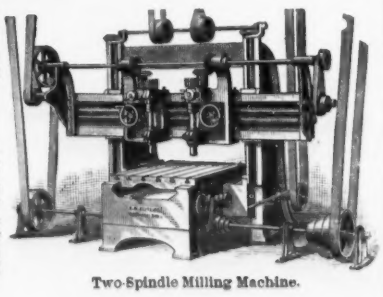

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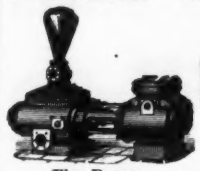

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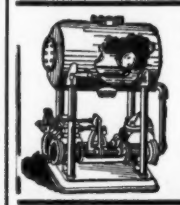

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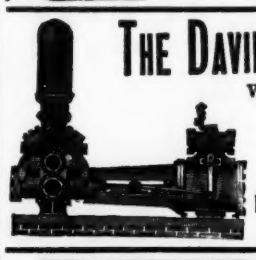

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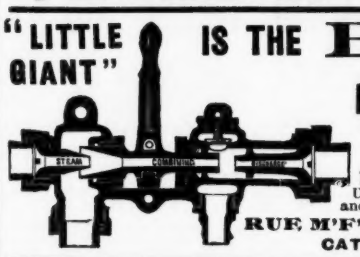

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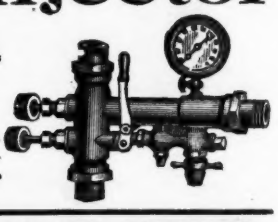

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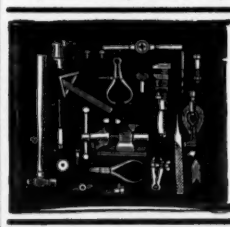

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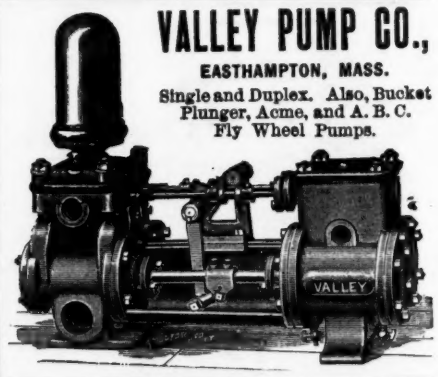

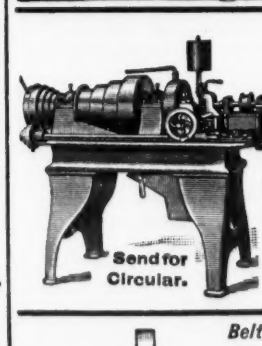

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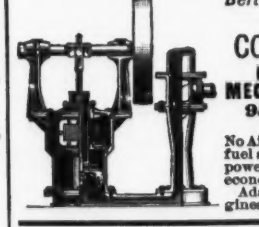

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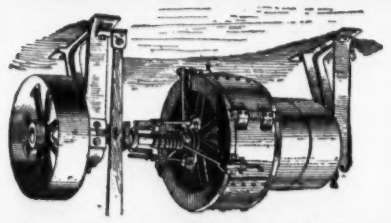

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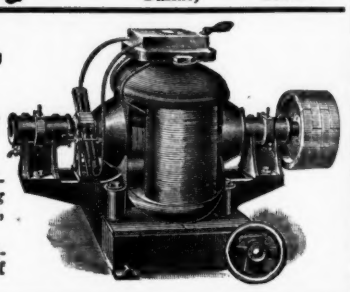

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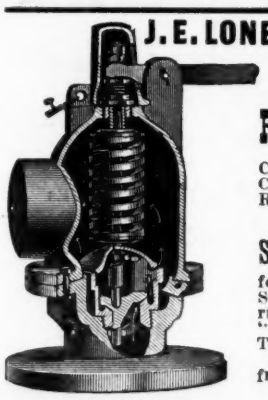

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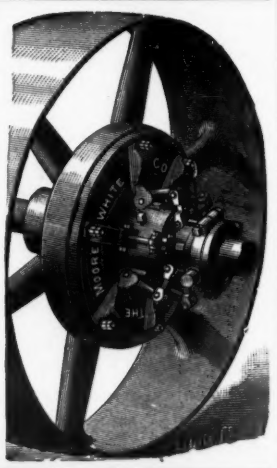

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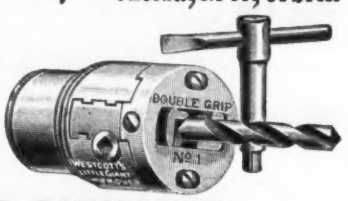

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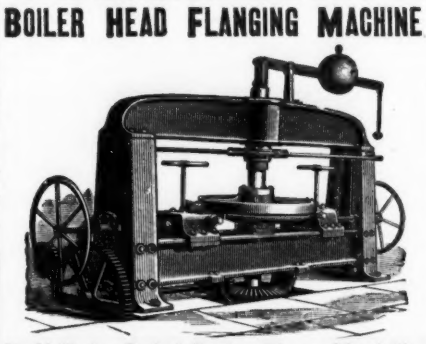

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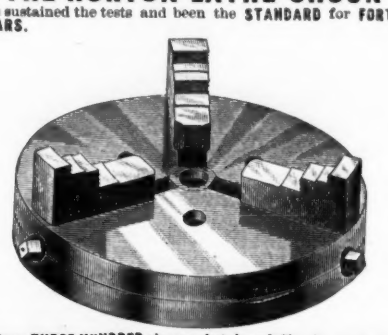

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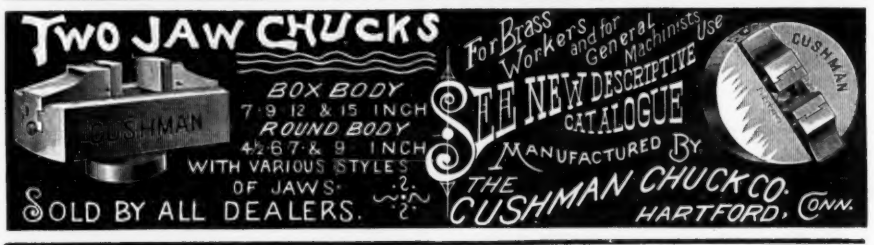

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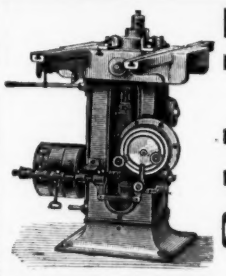

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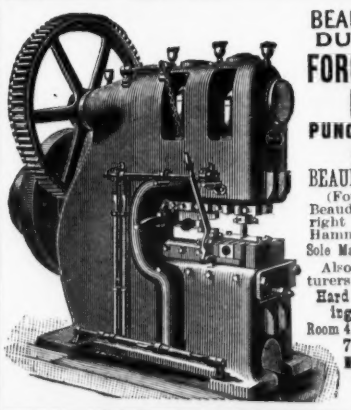

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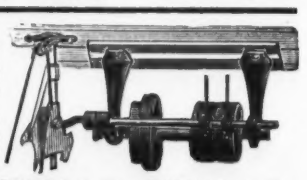

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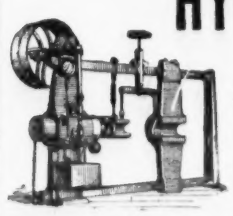

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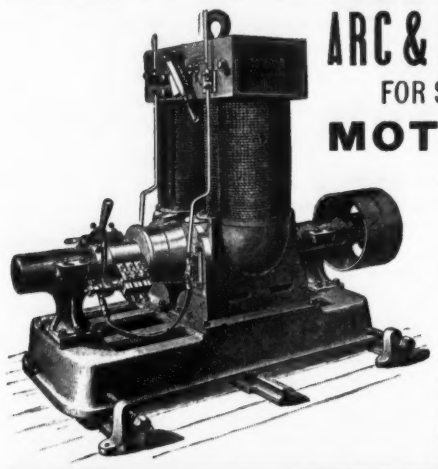

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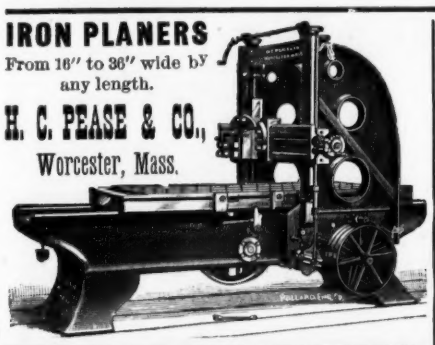

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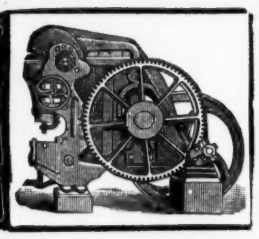

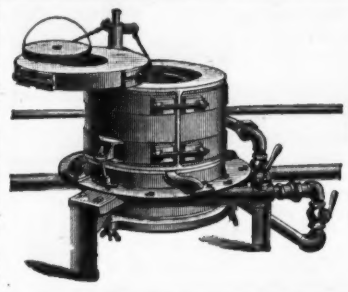

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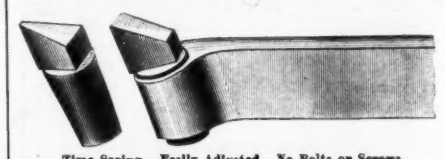

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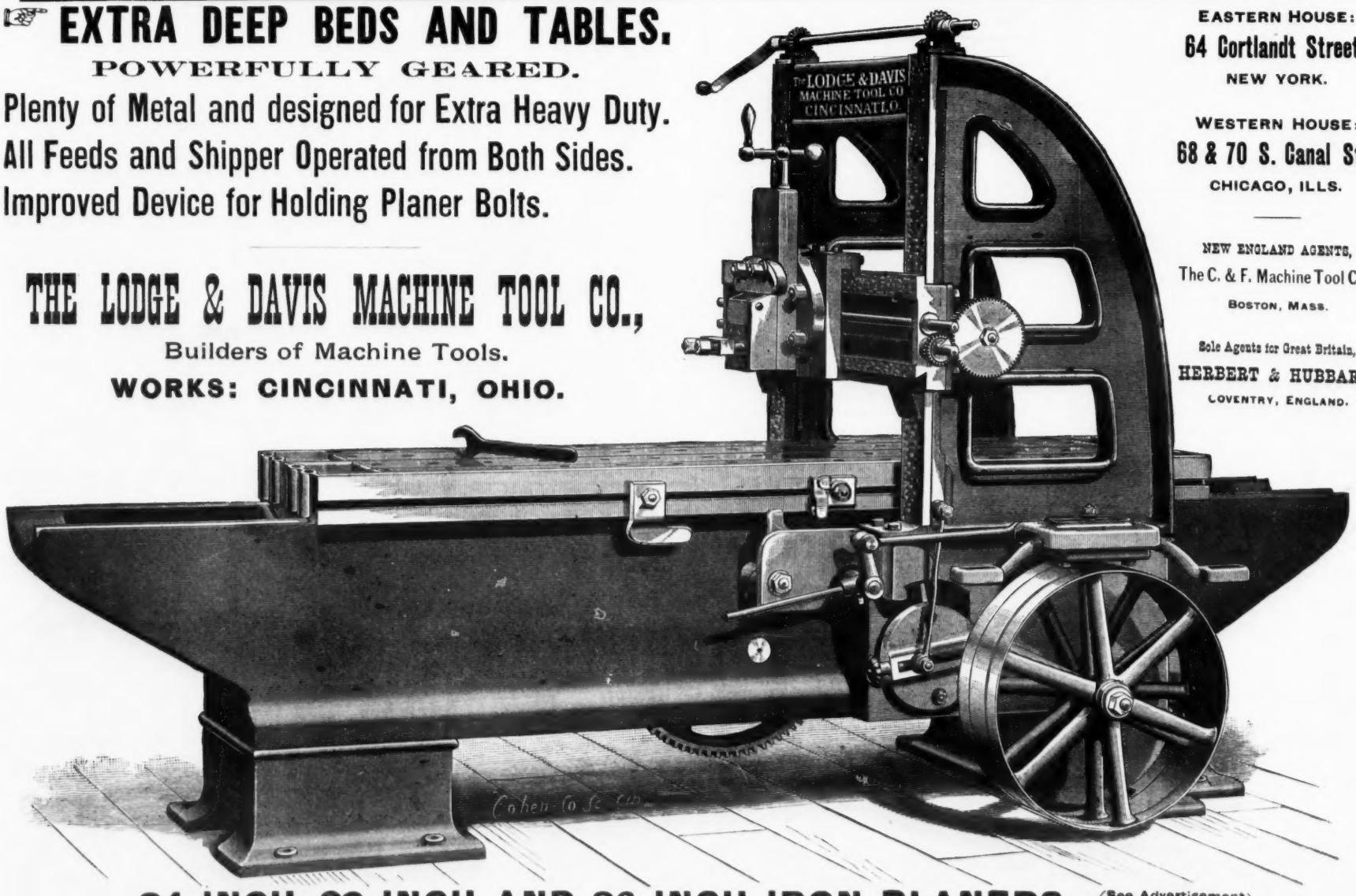

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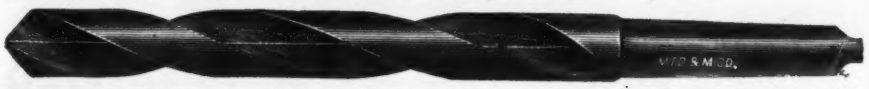

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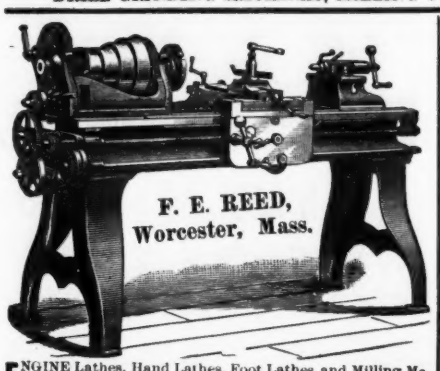

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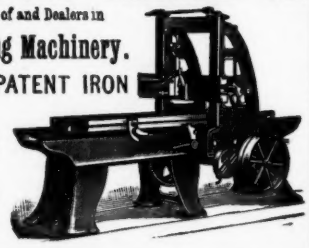

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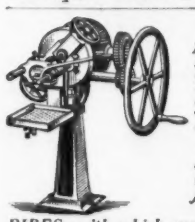

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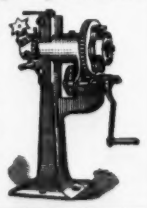

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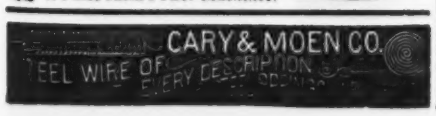

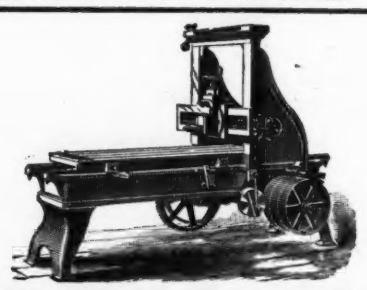

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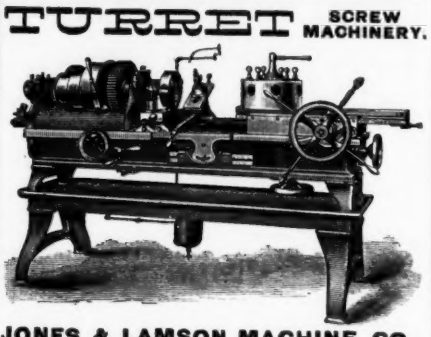

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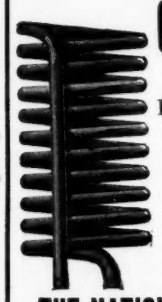

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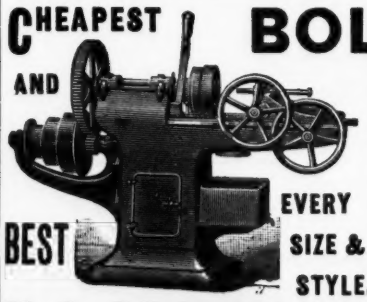

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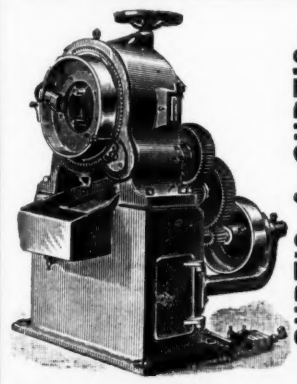

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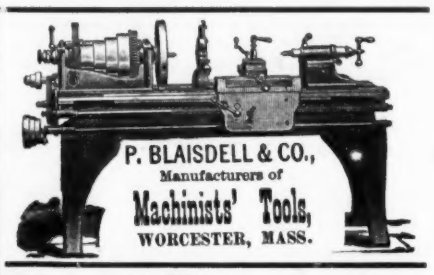

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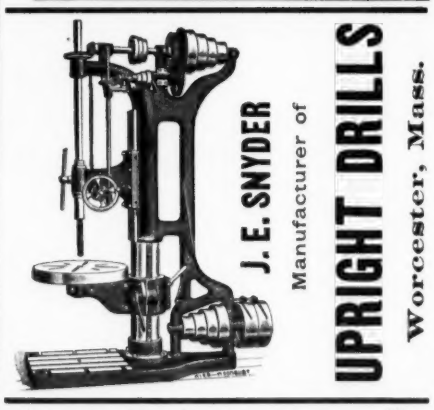

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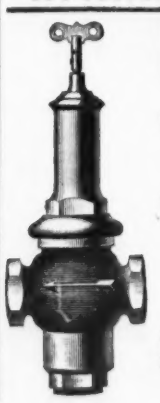

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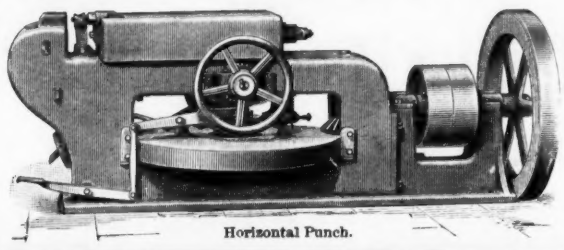
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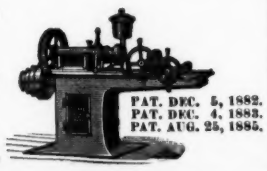
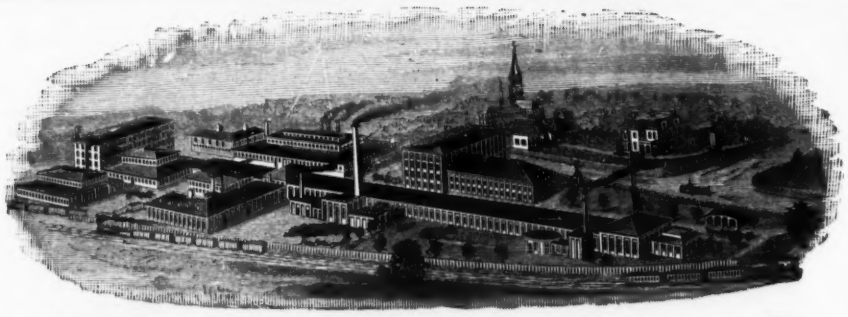

PAT. DEC. 5, 1882.
PAT. DEC. 4, 1883.
PAT. AUG. 25, 1885.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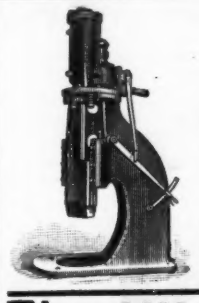
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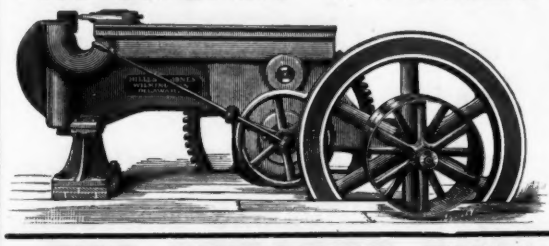
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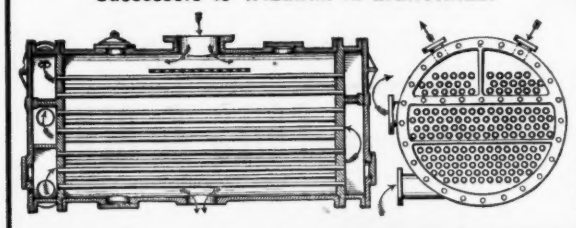
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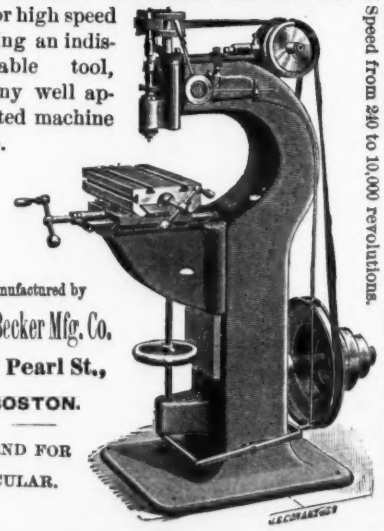
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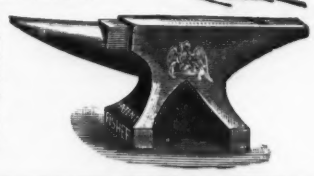

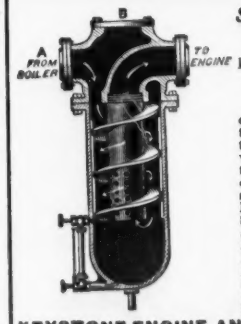

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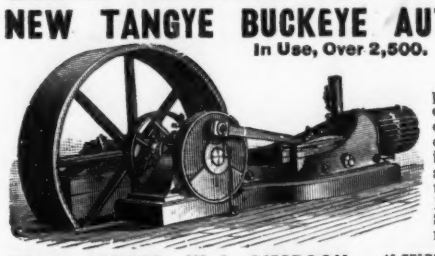

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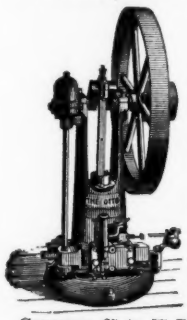

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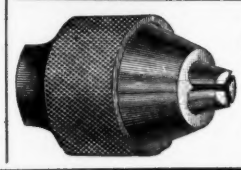

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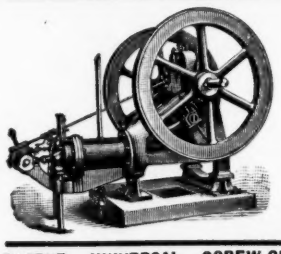

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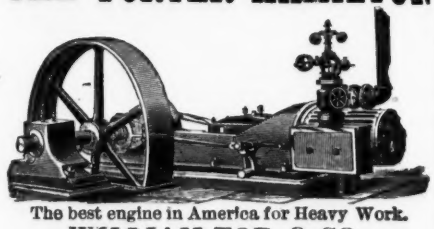

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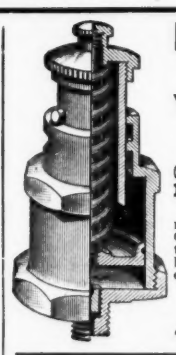

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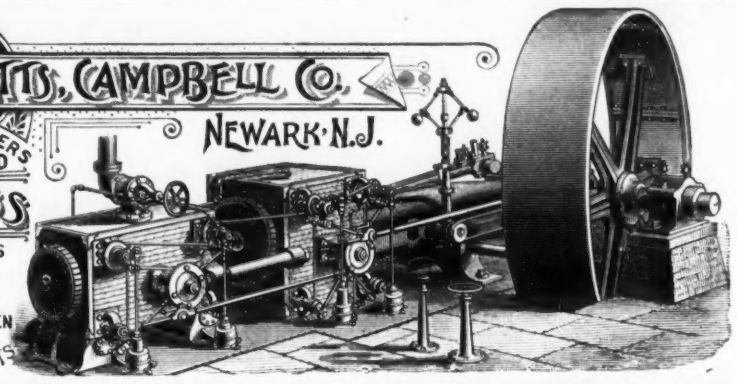

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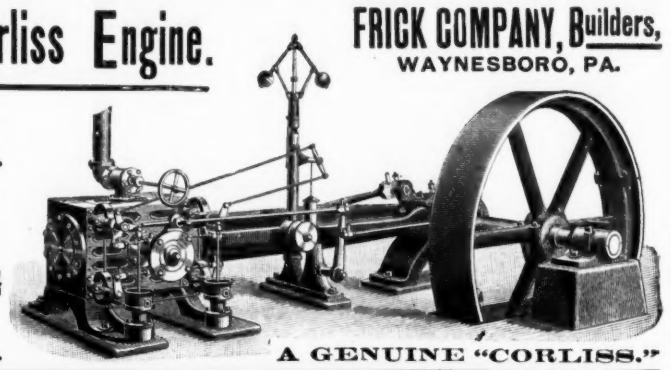

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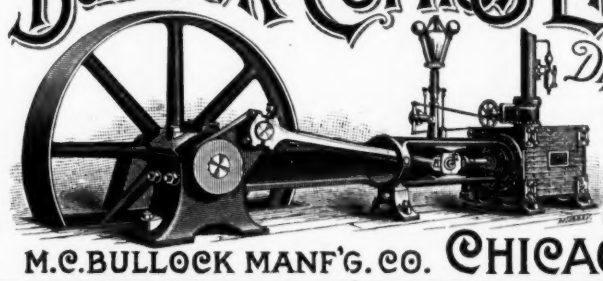

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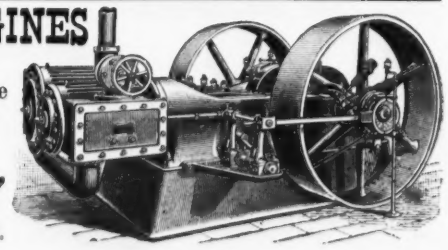

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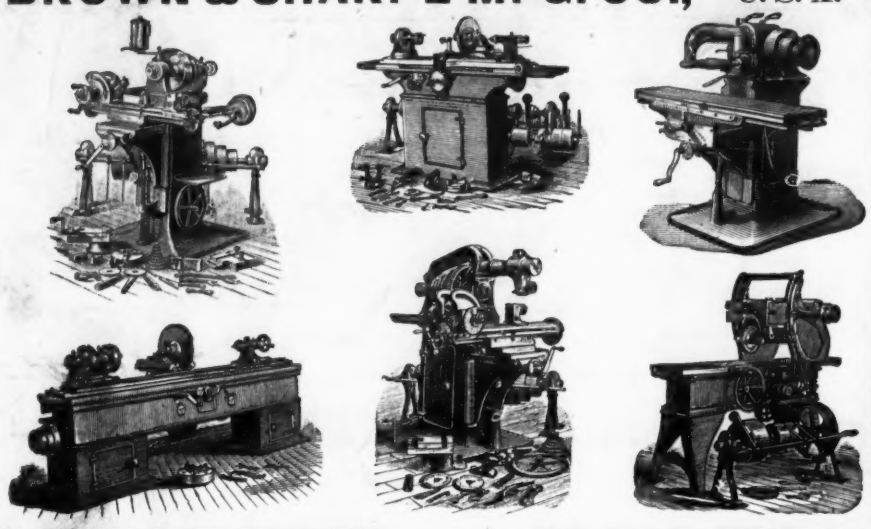

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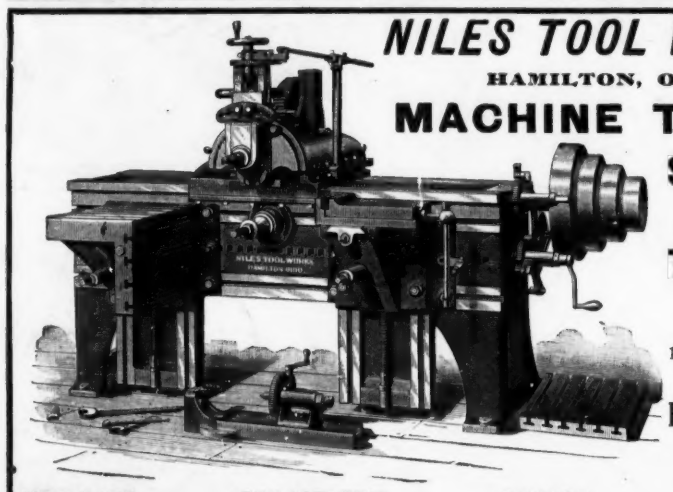

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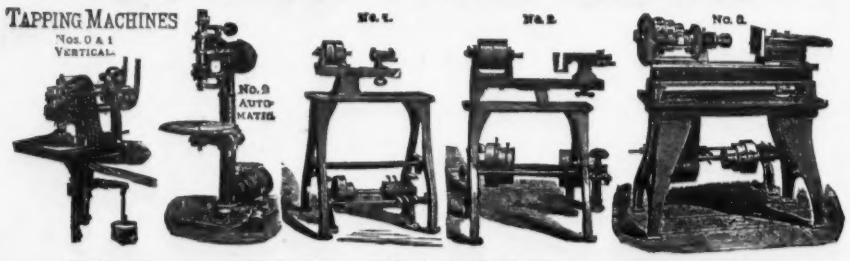

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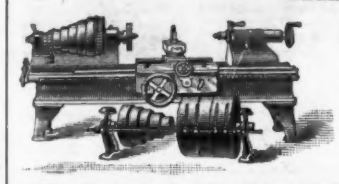

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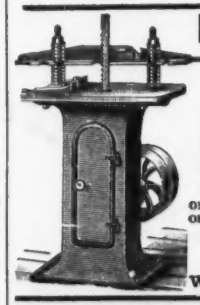

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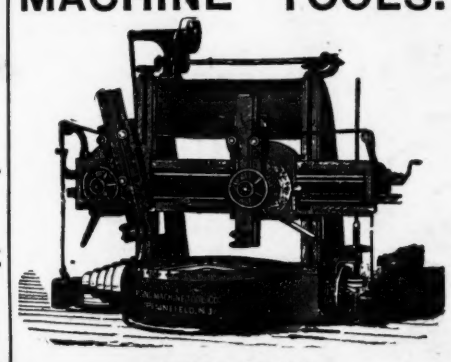

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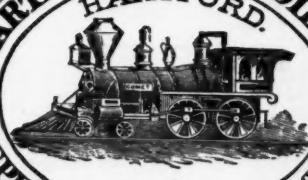

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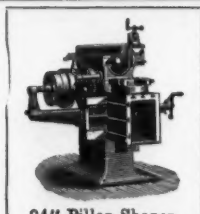

24″ Pillar Shaper.

15″ Pillar Shaper.

25″ Pillar Shaper.

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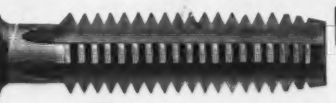

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